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International Jurisdiction over Standard-Essential Patents

Henrik Horn

European University Institute

Robert Schuman Centre for Advanced Studies

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Abstract

Standards often require the use of patented technologies. Holders of standard-essential patents (SEPs) typically commit to make their patents available on "fair, reasonable and non-discriminatory" (FRAND) terms. National competition authorities increasingly intervene against perceived FRAND violations. But *which* competition authority should regulate SEPs that affect more than one country? The paper uses a very simple economic framework to assess the impact of three main legal bases for allocating jurisdiction: territoriality, nationality, and cross-border effects. The findings are negative: neither base will implement a jointly efficient outcome, and the relative performance of the bases depends on the particular circumstances at hand.

Keywords

Standard-essential patents; international jurisdiction; default rules.

JEL Codes: F15; K21; K33; L40; O38

INTERNATIONAL JURISDICTION OVER STANDARD-ESSENTIAL PATENTS

Henrik Horn¹

The Research Institute of Industrial Economics (IFN), Stockholm

Bruegel, Brussels

Centre for Economic Policy Research, London

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1 Introduction

Technical standards are used in almost all industrial production processes. The standards are developed by standard-setting or standard-developing organizations, and are normally adopted voluntarily by firms. The standards often require the use of patented "standard-essential" technologies (SEPs). SEP holders and potential implementers negotiate the terms at which the latter can use the patented technologies. But the negotiations can be constrained by the fact as members of standards organizations, SEP holders have committed to make their patents available to implementers on "fair, reasonable and non-discriminatory" (FRAND) terms, should their patents become standard-essential. The purpose of these commitments is to limit the extent to which holders of SEPs can exploit the market power that the essentiality of their patents yields. The FRAND notion is very vague however, and conflicts often arise between SEP holders and potential implementers regarding the meaning of the concept. These conflicts frequently cause SEP holders to seek legal injunctions against the use of their technologies, claiming that implementers are unwilling to negotiate and/or accept FRAND terms, and they cause implementers to seek legal recourse against alleged unwillingness on part of SEP holders to license their technologies on FRAND terms.

Countries differ in their views on the legal nature of violations of FRAND commitments. In some countries, most notably the US, it is viewed primarily as a violation of private contract law. The main alternative approach is to view FRAND violations by SEP holders as possible antitrust violations (abuse of dominance, or similar). There is considerable debate regarding the appropriate scope for antitrust interventions.¹ But there is a trend toward this second approach; for instance, the EU, China, South Korea and Taiwan has recently applied their competition laws to SEPs.²

Standards are very often of interest to more than one country. For instance, standards often draw on technologies that have been developed by SEP holders with different nationalities, and the products involved are very often traded internationally. This would not cause any problem for the antitrust enforcement of FRAND commitments if all competition authorities would impose the same regulation. There are reasons to believe however, that competition authorities will tend to *promote national interests* when intervening to uphold FRAND commitments. Some authorities might be legally required to treat foreign interests different from national interests, just like the US Sherman Act does not apply to export cartels. Competition authorities might also be under domestic political pressure to favor domestic firms, or may be lobbied to do so by private parties. Another reason can be that countries are involved in different parts of the production chain. In such instances, even if the authorities pursue the same over-riding objectives, the pursuit of these objectives can lead to different decisions depending on the specific parts of the production chain that the authorities have jurisdiction over: For instance, a country that is mainly an implementer

¹See Hovenkamp (2020) for a recent legal analysis of the role for antitrust to regulate violations of FRAND commitments.

²Padilla et al (2018) provide an overview of antitrust enforcement in the EU, the US, Japan, China, India and South Korea, with particular focus on SEPs.

of SEP technologies might pursue a different FRAND policy than a country that is mainly a holder of the SEPs, even though they both seek to maximize, say, national social welfare.

There have been several cases recently where the international jurisdiction over FRAND commitments have been at issue, and where competition authorities have been alleged to pursue national objectives at the cost of the interests of other countries. For instance, China, Taiwan and South Korea have been criticized for using antitrust interventions against alleged violations of FRAND commitments as a form of industrial policy. In the words of Patrick Ventrell, US White House National Security Council spokesman:

The United States government is concerned that China is using ... anti-monopoly law, to lower the value of foreign-owned patents and benefit Chinese firms employing foreign technology.³

Similar concerns have been addressed by legal scholars and practitioners. For instance, Wong-Ervin et al. (2016) maintain that some competition authorities appear to enforce FRAND commitments in such a manner as to benefit their local implementers or national champions. This would be inconsistent with the pro-competitive goals of the competition laws of other jurisdictions. de Rassenfosse et al. (2018) find that China is less likely to accept applications for patent protection for foreign SEPs than for domestic SEPs. The notion that competition authorities sometimes use the enforcement of FRANDs commitments as means of achieving industrial policy objectives, is in line with the more general observation that there is a temptation for competition authorities in open economies to promote not only consumer welfare in the traditional sense, but also other objectives; see e.g. Mariniello et al. (2015).⁴

When the outcome of the FRAND enforcement depends on the identity of the regulating competition authority, the question arises: *Which competition authority should regulate?* There is no multilateral agreement to turn to in this regard, and rarely any other agreements. But this does not mean that there is a complete legal vacuum, since all countries are bound by the *Default Rules* in customary international law that apply to all countries absent international agreements. As will be briefly described below, the Default Rules identify several bases for jurisdiction, including territoriality and nationality. But application of these bases can often lead to overlapping jurisdictions, and the rules do not include a legal hierarchy among the bases.

The purpose of this paper is to identify, in the context of an extremely simple formal economic model of SEPs that are used in an international market, *pros and cons of three main bases for jurisdiction in the Default Rules*. Of particular interest is to determine whether any of the three

³Reuters, Dec 16, 2014. www.reuters.com/article/us-qualcomm-china-antitrust-idUSKBN0JU0AK20141216.

⁴Some observers question the notion that competition authorities pursue national interests at the expense of those of other countries is contested by some observers. For instance, Bradford et al (2017) examine the European Commission's response to the approximately 5 000 mergers reported to the Commission during 1990-2014. They find no evidence that the Commission has challenged non-EU mergers decisions to a larger extent than intra-EU mergers.

bases stands out as more suitable for addressing the international externality problems that are caused by national regulation of SEPs.

To the best of our knowledge, this is the first paper to deal with this issue. But there are obviously several related research areas. There is a very large economic literature on competition policy in international markets.⁵ There is also a considerable law and economics literature on SEPs. It mainly addresses what the notion of "reasonable" license fees should be taken to mean, and the circumstances under which SEP holders should be allowed to use injunctions against implementers for not agreeing to the requested terms for using the patented technologies.⁶ The literature does occasionally point to problems stemming from multiple jurisdictions for FRAND enforcement, but then typically emphasizes transaction costs that arise from differences in legal regimes, and the possibilities for SEP holders to choose courts that are prone to grant injunctions (forum shopping); see respectively Wong-Ervin et al. (2016) and Erixon and Bauer (2017). These aspects are not considered here.

The paper uses the simplest possible framework to examine the role of the jurisdictional principles for the regulation of SEPs. It assumes that a product is imported by a country A from a country B. The product uses a standard that builds on two essential patents, 1 and 2, that are issued by country A, and with two separate owners; for simplicity there is no demand for the product in country B. The producer in country B simultaneously negotiates per unit license fees with each of the two SEP holders. The holders of these SEPs are bound by FRAND commitments to accept "reasonable" fees.

In each country there is national competition authority that, depending on the allocation of jurisdiction, may decide to intervene to enforce FRAND commitment(s). The authority in country A, denoted CA, is concerned with consumer welfare. But it also puts a value on the revenue that its SEP holder(s) obtains, this being a short-hand for incentive effects on innovation. The objective function of the competition authority in country A is thus a weighted sum of consumer surplus, and the license revenue of the country A SEP holder(s), if any. There is no consumption taking place in country B, but CB, its national competition authority, may still want to enforce FRAND commitments since it is concerned with the license revenue(s) of the country B patent holder(s), if any, and possibly also the profit of its exporter. We might thus think of country B as say China or Korea, countries with large export interests, and country A as the EU or the US, say. Each competition authority will view a per unit license fee to be "reasonable" in the sense of the FRAND notion if it balances the authority's trade-off between protection of the interests of the domestic SEP holder(s), and other objectives it has.

⁵Garcia et al (2018) is a recent contribution to the formal analysis of national competition policy enforcement in international markets. Mariniello et al (2015) discuss the consequences of regulatory capture among competition authorities for international economic integration.

⁶See e.g. Contreras (2019) for a survey of the literature on standard-setting organizations. Formal analyses of the FRAND notion are undertaken by e.g. Choi (2014), Froeb et al (2012), Langus et al (2013), and Lerner and Tirole (2015). Layne-Farrar (2017) provides an overview of the economic literature on SEPs. These papers do not focus on international/jurisdictional issues, however.

The interaction takes place in three stages. In the first stage the competition authorities simultaneously lay down FRAND policies for the patent(s) for which they have jurisdiction. Since the authorities can only intervene against exploitation of market power by the SEP holders, they cannot implement higher per unit royalty fees than the SEP holders and the producer would negotiate, should they want this. The authorities can only impose upper limits on permissible negotiated fees. If the competition authorities impose differently stringent constraints on the same license fee, the SEP owner will follow the more stringent regulation, in order to comply with both authorities' regulations. In the second stage there are simultaneous separate negotiations between the producer and each of the two SEP owners regarding the per unit royalty fees. These negotiations are interrelated, since the surplus that can be divided between each of the SEP holders and the producer, will be adversely affected by the license fee that they expect to be agreed upon between the producer and the other SEP holder. To formally capture this, the outcome is assumed to be a "Nash-in-Nash" equilibrium, as in Horn and Wolinsky (1988a,b).⁷ In the final stage there is production and consumption in standard fashion. The assumption that the FRAND enforcement is determined before the negotiations over the license fees is meant to capture the long-run aspects of the enforcement of FRAND commitments. For some of the cases to be considered it does not matter whether the regulation is laid down before or after the negotiations over the license fees, but for other it would matter.

There are two critical assumption in the paper. The first is that national competition authorities are only concerned with the welfare of their *domestic* agents, their innovator(s), consumers, or producers, but disregard any effects from their decision on the partner country. This implies that the outcome with national enforcement of the FRAND commitments will in general be *inefficient* from the perspective of the competition authorities joint objectives, the sum of their objective functions. The second basic assumption is that when a FRAND commitment is regulated by both competition authorities, the SEP holder will comply with the most stringent of the regulations that are imposed upon the negotiation. Combined with the former assumption, this implies a tendency toward *over-regulation* absent any rules on jurisdiction.

The stage is thus set to address the question of whether the Default Rules in customary international law can help steer the countries toward a jointly better outcome compared to the outcome when the authorities make unilateral decisions regarding whether to regulate. The paper focuses primarily on the Territoriality and the Nationality Principles, and to a lesser extent on the Effects Principle. The Territoriality Principle gives countries jurisdiction over acts, actors or objects within their territories; the Nationality Principle gives countries jurisdiction over their nationals irrespective of territorial aspects; and the Effects Principle gives jurisdiction based on cross-border effects regardless of the nationality of the acts, actors or objects involved. The paper also considers

⁷Our model share certain basic features with the more elaborate dynamic model with endogenously determined research and development, inventor-producer bilateral bargaining, and subsequent Bertrand product market competition, developed by Spulber (2019).

the interaction between these principles and a National Treatment obligation. The latter provision may form part of a trade agreement between the countries, or could potentially be part of an international agreement on FRAND regulation.

The analysis to follow will be somewhat taxonomic. First, it will cover three bases for jurisdiction in the Default Rules as well as a couple of versions of a National Treatment provision. The three jurisdictional bases can in turn be applied to acts, actors, and objects. There are reasons to believe that the regulatory outcome that follows from the different legal constellations depend on the pattern of ownership of the SEPs. The analysis will therefore consider three cases in this regard: where both SEP holders are country A nationals, where both are country B nationals, and where one of the owners is a national of country A and the other of country B. Each of these ownership patterns captures a qualitatively different aspect of the interaction between the competition authorities. These different aspects produce a very large number of cases to potentially consider. But as it turns out, many of them are not of practical interest.

A general finding from the analysis is that neither of the three examined bases for jurisdiction in the Default Rules will implement an efficient outcome, and will normally not do so even if complemented with a National Treatment provision. Furthermore, it does not seem possible to establish a robust hierarchy among the bases with regard to their performance from a joint welfare perspective. Allocating jurisdiction according to either of the bases in the Default Rules will only improve joint welfare to the extent that the country that is designated to have jurisdiction over a particular FRAND commitment *prefers a more lenient* regulation. However, when jurisdiction is allocated to the competition authority preferring a more lenient treatment, it will *disregard the international repercussions* of its decisions. As a result, the Territoriality Principle gives too weak enforcement of FRAND commitment(s) when the patent(s) is (are) owned by nationals of the country that has issued the patents, and too stringent enforcement when they are owned by foreign interests. Second, the Nationality Principle gives too lenient enforcement for all patterns of ownership of the patents. Finally, the Effects Principle give too stringent enforcement regardless of ownership pattern.

Two more general observation emerge from the above findings:

- When the Default Rules yield jurisdictions that are not overlapping, there will be too lenient enforcement of the regulating SEPs of the regulating country (-ies), and too stringent regulation of the other SEPs.
- Whenever jurisdiction is overlapping, the FRAND regulation will be too will be too strict.

The Default Rules thus have clear drawbacks as a means of allocating jurisdiction with regard to the FRAND regulation in two respects: First, none of the bases for jurisdiction in the Default Rules will normally implement an efficient outcome. Second, it does not seem possible to identify a hierarchy for the performance of the different bases. These findings are not surprising, considering

that the rules did not emerge to solve jurisdictional problems with regard to FRAND enforcement. But findings are nevertheless of interest, since countries are typically bound by the Default Rules absent international agreements. The ineffectiveness of the rules suggests a need for some form of international agreement. But as will be briefly discussed towards the end of the paper, it is not clear what could be agreed upon in practice.

The structure of the paper is as follows. The next section gives a brief description of the Default Rules for international jurisdiction. Section 3 lays out the simple economic model. Section 4 derives and compares the outcomes with the three main bases for jurisdiction in the Defaults Rules. Section 5 considers implications of imposing a National Treatment obligation on the parties. Section 6 summarizes the findings, and discusses some alternatives to relying on the Default Rules. The Appendix uses the simplest possible linear version of the already very simple model to show the inherent ambiguity of the joint welfare comparisons of the different jurisdictional regimes.

2 The Default Rules for jurisdiction in customary international law

There is no multilateral treaty on the allocation of jurisdiction for antitrust. All countries are therefore bound by the customary international law rules regarding jurisdiction, often referred to as the "Default Rules" for jurisdiction.^{8,9} Being customary, these rules are not codified in any generally agreed-upon text. But a widely accepted interpretation of these rules is the series of *Restatements of Foreign Relations Law of the United States* by the American Law Institute (ALI).¹⁰ In what follows, we will draw on the very recent Restatement ALI (2018) to briefly describe main features of current jurisdictional rules in customary international law.¹¹

There are three forms of jurisdiction. Jurisdiction to *prescribe* gives a country authority to make laws that apply to *actors*, *acts* or *objects*. Jurisdiction to *adjudicate* allows the country to apply its laws. Jurisdiction to *enforce* allows a state to intervene to induce compliance with laws. These are clearly separate aspects of jurisdiction. But we will not distinguish between these aspects in what follows. We will instead assume that if a competition authority has jurisdiction to prescribe, it also has jurisdiction to adjudicate and enforce, this being the prime case of interest from an economic perspective.

⁸Customary international law is formed when states act in a consistent fashion out of a sense of obligation. It applies to international relations in instances where there is no international treaty governing the relationship. The exception is if a country has persistently objected to a custom. But this does not appear to be of practical relevance to SEPs.

⁹The basic rules concerning jurisdiction were spelled out in the classic "Lotus judgment" in 1927 by the Permanent Court of International Justice (the predecessor of the International Court of Justice).

¹⁰The ALI was founded in 1923 and its membership consists of 3 000 leading US legal scholars and professionals. ALI Restatements seek to clarify the state of the law for US courts, and are often used by courts as authoritative interpretation of the law.

¹¹See also Lundstedt (2016) for a comprehensive description and analysis of jurisdictional principles, in particular as they apply to intellectual property law.

In order for a state to have jurisdiction to prescribe there must be a "genuine connection" between the subject of the regulation and the state seeking to regulate. Such a connection might stem from one or several bases:¹²

- *Territoriality Principle*: The oldest, most frequently used, and least controversial base is that a state can regulate actors, acts and objects within its geographic territory;
- *Active-Nationality Principle*: Another base with a long tradition is the nationality of actors for acts committed outside its territory;
- *Effects Principle (or Doctrine)*: A more controversial, but increasingly common, base is effects that emanate outside a state's territory but have (or are intended to have) substantial effect within the state's territory. This base is particularly commonly referred to in the area of antitrust; and
- *Passive-Nationality Principle*: Another controversial but increasingly common justification for regulating conduct outside a state's territory is to protect domestic nationals against harm.

This list is not exhaustive, but probably includes the bases of main interest with regard to SEPs.

A central feature of the Default Rules is that they simultaneously can give jurisdiction to *more than one party*. For instance, in the case of SEPs, the territorial applicability of a patent, and the nationality of the holder of the patent, might point in different directions with regard to which party should have jurisdiction. In the past there was a clear hierarchy in international law according to which the Territoriality Principle dominated the both Nationality Principle and the Effects Principle; see the ALI (1987) Restatement. But the recent ALI (2018) Restatement unequivocally states that there is *no hierarchy* among the bases in international law, even if some bases are more controversial than others.

In what follows we will focus on three jurisdictional bases that seem most relevant to SEPs: territoriality, active nationality ("nationality" for short below), and effects. With three jurisdictional bases that can be applied to three targets for regulation—acts, actors, and objects—there are in principle nine possible sources of jurisdiction. But not all of them seem relevant to SEPs, however, as we will argue below.

A possible solution in case of conflicting jurisdiction is *comity*, that is, that countries that would have jurisdiction defer other countries to exercise jurisdiction, if the latter have larger legitimate interests at stake.¹³ There is no requirement in customary international law for states to do so. But countries nevertheless occasionally do this unilaterally through domestic laws and regulations that constrain the exercise of prescriptive jurisdiction. There are also some international comity

¹²ALI (2018) points to two additional bases: the protective principle, which is concerned with national security, and universal jurisdiction, which concerns interventions in the case of crimes against humanity etc. These are omitted since they seem irrelevant to the issues at stake in this paper.

¹³See Drahozal (2012) for a discussion of economic aspects of comity.

agreements, the most well-known is probably the 1998 EU-US positive comity agreement, under which each side may request the other side to remedy anti-competitive behavior which originates in the other side's jurisdiction but affects the requesting party.

3 The model

In what follows we will employ the simplest possible economic framework to capture some basic consequences of the Default Rules. A product is imported by country A from country B, where it is produced by a monopoly firm. The product is based on a standard that draws on two essential patents, denoted 1 and 2, with separate holders. The firm negotiates separately and simultaneously with each SEP holder a license fee— r_1 and r_2 , respectively—per unit sold of the final product in market A.

The patents are essential in two respects. First, the product cannot be produced without the use of both patents, and second, the standard has been developed based on FRAND, implying a commitment on behalf of the patent holders not to charge too high license fees. In each country there is a competition authority, denoted respectively CA and CB. Depending on their jurisdiction, the authorities can seek to enforce the FRAND commitments. There are three stages in the interaction for any given allocation of jurisdiction over the SEPs:

1. Each competition authority decides on a ceiling for each license fee for which it has jurisdiction;
2. License fees are negotiated, respecting any FRAND regulations; and
3. Production and consumption takes place.

3.1 The product market

The product market is as simple as it could be. Consumer demand $D(p)$ in market A is given by

$$D(p) \equiv \arg \max_c \tilde{U}(c) - pc$$

where $\tilde{U}(c)$ is gross consumer welfare, p is the good price, and c is the level of consumption. For given license fees, the single producer maximizes its profit in standard fashion, choosing the price

$$P(\mathbf{r}) \equiv \arg \max_p (p - r_1 - r_2)D(p),$$

where \mathbf{r} denotes the vector (r_1, r_2) . By the second-order condition (SOC), the optimal price increases in each of the license fees, and it is assumed to increase less than proportionally in each of the

fees:¹⁴

$$0 < P_i(\mathbf{r}) < 1;$$

with sub- or superscript i denoting $i = 1, 2$, $i \neq j$. The maximized profit is

$$\Pi(\mathbf{r}) \equiv [P(\mathbf{r}) - r_1 - r_2]D(P(\mathbf{r})),$$

and the resulting maximized consumer welfare is

$$U(\mathbf{r}) \equiv \tilde{U}(D(P(\mathbf{r}))) - P(\mathbf{r})D(P(\mathbf{r})).$$

Both obviously fall in the level of the license fees:

$$\Pi_i = -D < 0 \text{ and } U_i = -DP_i$$

3.2 License fee negotiations absent regulation

The monopoly firm negotiates the license terms simultaneously with the two SEP holders, legally constrained by a FRAND commitment. The outcome of the bargaining is assumed to be a "Nash-in-Nash" equilibrium, as in Horn and Wolinsky (1988a,b). Hence, each negotiation is thus pursued with correct expectations concerning the fee to be agreed upon in the other, simultaneous negotiation. Assuming zero reservation utilities for all parties since both patents are standard-essential, the negotiation between the monopolist and the SEP holders yield a pair of fees that solve

$$\begin{aligned} \max_{r_1} \Pi(r)L^1(\mathbf{r}) \\ \max_{r_2} \Pi(r)L^2(\mathbf{r}) \end{aligned}$$

where $L^i(\mathbf{r}) \equiv r_i D(P(r_i, r_j))$ is the license revenue for patent i . The associated first-order conditions (FOCs) for an interior solution to the negotiation over fee r_i is¹⁵

$$\Pi_i(\mathbf{r})L^i(\mathbf{r}) + \Pi(\mathbf{r})L_{ii}^i(\mathbf{r}) = 0$$

¹⁴We assume throughout the paper that SOC's are fulfilled for any optimization problems we consider. But in the linear version of the model, reported in the Appendix, we verify whether such conditions are fulfilled or not. In the linear model $0 < P_i < 1$.

¹⁵The SOC is

$$\Pi_{ii}L^i + 2\Pi_iL_{ii}^i + \Pi L_{ii}^i < 0$$

It is fulfilled for all feasible r_i in the linear version of the model.

This expression defines a function $N^i(r_j)$ that gives the negotiated fee r_i for any given r_j , if the outcome of the negotiation is not constrained by enforcement of FRAND commitments:

$$N^i(r_j) \equiv \arg \max_{r_i} \Pi(\mathbf{r}) L^i(\mathbf{r})$$

We assume that the fee r_i that is negotiated between SEP holder i and the firm is higher fee, the lower is the fee r_j for the other SEP:

$$N_j^i < 0 \quad (1)$$

This is natural assumption since a smaller r_j will give more surplus to be divided between the producer and SEP i holder, and part of this additional surplus will accrue to the holder of SEP i in the form of a higher r_i . We further assume that there is a unique equilibrium $\mathbf{r}^0 \equiv (r_1^0, r_2^0)$, given by

$$\begin{aligned} r_1^0 &= N^1(r_2^0) \\ r_2^0 &= N^2(r_1^0) \end{aligned} \quad (2)$$

for the unconstrained negotiations. Due to the symmetry of the setting, we focus on symmetric outcomes, $r_1^0 = r_2^0 \equiv r^0$. We also make the standard type of assumption that the interaction between the two bargaining processes is "stable" in the sense that the relative slope of the two functions in (2) is such that at (r^0, r^0) ,

$$\left. \frac{dr_2}{dr_1} \right|_{N^1} < \left. \frac{dr_2}{dr_1} \right|_{N^2} < 0,$$

that is, that

$$N^j(N^i(r_j)) > (<) r_j \text{ for } r_j < (>) r^0. \quad (3)$$

This property always holds in the linear version of the model considered in the Appendix.

3.3 Enforcement of FRAND commitments

The two conditions in (2) specify the outcome $\mathbf{r}^0 \equiv (r^0, r^0)$ for the case where the negotiations are unconstrained by regulatory interventions. We now turn to first stage, in which competition authorities can lay down their regulation of the FRAND commitments.

3.3.1 Competition authorities

The country A competition authority is concerned with consumer welfare, and the revenue of any SEP holder(s) that are country nationals. The objective of CA is

$$V^A(\mathbf{r}) \equiv U(\mathbf{r}) + \alpha[\delta_1 L^1(\mathbf{r}) + \delta_2 L^2(\mathbf{r})] \quad (4)$$

The first term captures standard consumer surplus. The parameters δ_i in the second term index the nationalities of the two SEP holders, with $\delta_i = 1$ ($\delta_i = 0$) denoting that holder i is a national of country A (B). The term in brackets is thus the revenue of the license holder(s) that is (are) country A nationals, if any, and the parameter $\alpha > 0$ is the relative weight that CA puts on the license revenue. The function $V^A(\mathbf{r})$ captures in the simplest possible fashion the conflicting objectives of a competition authority with regard to the license fees for SEPs. The fees are undesirable from a consumer perspective, since they drive up the consumer price. But the competition authority is not immune to the basic idea behind the patent system, which is to create incentives for innovations by allowing successful innovators certain monopoly power. The second term in (4) is hence a shorthand for a more elaborate model with endogenous innovation.¹⁶ Alternatively, it could represent the notion the competition authority is not entirely immune to lobbying pressure from domestic SEP holders.

There is no consumption in country B. But country B is still affected by the negotiated fees. First, one or both of the SEP holders might be nationals of country B, so the competition authority in country B might be concerned with their revenue. Second, the producer is a national of country B, and production occurs in country B, so the authority might be concerned with the profit of the producer.¹⁷ The producer might be important to country B as an employer, as a generator of incomes for share-holders, and/or as a source of tax revenue. The objective of CB is to maximize

$$V^B(\mathbf{r}) \equiv \alpha[(1 - \delta_1)L^1(\mathbf{r}) + (1 - \delta_2)L^2(\mathbf{r})] + \gamma\Pi(\mathbf{r}) \quad (5)$$

where $\alpha > 0$ and $\gamma \geq 0$.

It might appear odd that the weight α appears in both objective functions. This will not constrain decisions by the two authorities to be the same with regard to the FRAND regulations, since both authorities will trade off license revenues for their respective SEP holder(s), if any, against another objective. CA is also concerned with consumer welfare, and CB with the profits of its producer. Hence, for the decisions on the FRAND regulations, it is only the relative weights on the different components of the objective function that matter. The assumption regarding the absolute weight on the license component does matter however, when evaluating the efficiency of the various outcomes with joint welfare, that is, with the sum of the welfare of the two competition authorities:

$$W(\mathbf{r}) \equiv V^A(\mathbf{r}) + V^B(\mathbf{r}) \quad (6)$$

$$\equiv U(\mathbf{r}) + \alpha[L^1(\mathbf{r}) + L^2(\mathbf{r})] + \gamma\Pi(\mathbf{r}) \quad (7)$$

Hence, the implication is that revenue is equally valuable from a global point of view regardless

¹⁶See Spulber (2019) for an analysis of SEPs with endogenously determined research and development.

¹⁷For CB to be affected by the enforcement of the FRAND commitments, we exclude the situation where both $\delta_1 = \delta_2 = 1$ and $\gamma = 0$.

of whether it accrues to one or the other of the SEP holders. An alternative presentation of the model would be to start with the global welfare function on the second line above, and then delegate the objective of maximizing $W(\mathbf{r})$ regionally, by letting CA maximize $U(\mathbf{r}) + \alpha L^1(\mathbf{r})$, and CB $\alpha L^2(\mathbf{r}) + \gamma \Pi(\mathbf{r})$.

Let the pair of license fees that maximize $W(\mathbf{r})$ be denoted \mathbf{r}^J , with $r_1^J = r_2^J \equiv r^J$ due to symmetry. Each of these fees r_i^J balances the positive effect on the revenue for the holder of SEP i , and the adverse effects of the fees on consumer surplus, on holder of SEP j , and possibly also on the profit of the producer (depending on whether $\gamma \geq 0$):

$$\begin{aligned} W_i &= U_i + \alpha L_i^i + \alpha L_i^j + \gamma \Pi_i \\ &= (\alpha - P_i - \gamma)D + \alpha(r_i + r_j)D_p P_i, \end{aligned}$$

where the terms U_i , αL_i^j and $\gamma \Pi_i$ are all negative, and where αL_i^i is positive for small r_i .

It will be assumed that the marginal impact of each license fee is more negative, the larger is the other fee:

$$W_{12} < 0 \tag{8}$$

This assumption is stronger than necessary for what follows, but is assumed for simplicity and since it seems reasonable. It is fulfilled for all relevant α in the linear version of the model.

Importantly for what follows, we will focus on situations where the unconstrained jointly efficient regulation *restricts the negotiated outcome, but still allows for strictly positive fees for the SEPs*; that is, we assume throughout that $(0, 0) < \mathbf{r}^J < \mathbf{r}^0$.¹⁸ This is a natural assumption since it only excludes cases where the jointly efficient outcome is to deny the SEP holders any revenue ($\mathbf{r}^J = 0$), and to leave the market unregulated ($\mathbf{r}^J \geq \mathbf{r}^0$). The jointly optimal license fees are hence given by¹⁹

$$V_i^A(\mathbf{r}^J) + V_i^B(\mathbf{r}^J) = 0. \tag{9}$$

3.3.2 The impact of regulation on negotiated license fees

Interventions by the competition authorities are constrained in two respects: First, authorities can only intervene with regard to patents for which they have *jurisdiction*. Second, being competition authorities rather than more general regulatory agencies, the authorities can only intervene to limit the patent holders' exploitation of market power in the form of high fees for the patents, that is, they can only impose *upper limits on permitted license fees*. The competition authorities cannot implement higher fees than what is negotiated between the producer and the respective patent holder, should they so prefer.

In case both authorities impose restrictions on a particular license fee, the SEP holder is as-

¹⁸Here and in what follows we let vector notation $\mathbf{r} < \mathbf{r}'$ denote $r_i < r'_i$, $i = 1, 2$, etc..

¹⁹A necessary condition for $r_i^J > 0$ is that $\alpha - \gamma > P_i$, where $0 < P_i < 1$.

sumed to comply with both determinations by respecting the more stringent of the two regulations. Formally, let m_i^A and m_i^B be the maximal fees allowed by the respective competition authority for SEP i . The maximal permitted fee for SEP i will then be $m_i \equiv \min(m_i^A, m_i^B)$. Let $\mathbf{m} \equiv (m_1, m_2)$ be the pair of most binding regulations.²⁰

Four types of situations may arise as a result of the regulatory decisions. First, if both fees are regulated to levels below what would result without regulation—that is, $\mathbf{m} < \mathbf{r}^0$ —both interventions will bind: $\mathbf{r} = \mathbf{m}$. Second, in the opposite case where neither of the interventions affects the negotiated outcomes—that is, $\mathbf{m} \geq \mathbf{r}^0$ —the outcome is the pair of fees resulting from unconstrained negotiations: $\mathbf{r} = \mathbf{r}^0$.

There are also asymmetric cases. One such case is where one of the constraints is lax enough not to bind regardless of the negotiated fee for the other SEP. In this case the implemented fee for the leniently treated SEP will be determined through an unconstrained negotiation, which is affected by the other fee. For instance, suppose $m_2 > N^1(0)$ as illustrated in Figure 1. The feasible outcomes are then $\mathbf{r} = (m_1, N^2(m_1))$ —the thick line in the figure—where $r_1 \in [0, r^0]$ is the implementable range of r_1 for CA.

Another asymmetric case arises when $r^0 < m_2 < N^2(0)$. There will then be a critical value of m_1 for any m_2 , denoted $\hat{R}^1(m_2)$, which is the level of m_1 that would induce the unconstrained negotiation over SEP 2 to result in the fee m_2 . That is, $\hat{R}^1(m_2)$ is given by $N^2(\hat{R}^1(m_2)) \equiv m_2$, and $\hat{R}^i(r_j)$ is more generally given by

$$N^j(\hat{R}^i(r_j)) \equiv r_j. \quad (10)$$

As illustrated in Figure 2, for $m_1 \leq \hat{R}^1(m_2)$, the implemented fee r_1 would be sufficiently low that the regulation $r_2 \leq m_2$ restricts the outcome of the negotiation over r_2 . In this case the implemented outcome will be $\mathbf{r} = (m_1, m_2)$; this is the horizontal part of the thick line in the figure.

Finally, for $\hat{R}^1(m_2) < m_1 < r_1^0$ the outcome of an unconstrained negotiation regarding r_2 would be a lower fee than m_2 , in which case the regulation $r_2 \leq m_2$ would not bind. The outcome in this case is $\mathbf{r} = (m_1, N^2(m_1))$.

The outcome of the regulations can hence be summarized as follows:

Lemma 1 *The negotiated fees \mathbf{r} depend on the regulations \mathbf{m} as follows:*

$$\mathbf{r}(\mathbf{m}) \equiv \begin{cases} \mathbf{m} & \text{if } \mathbf{m} < \mathbf{r}^0 \\ (m_i, \min(m_j, N^j(m_i))) & \text{if } m_i < r_i^0 \text{ and } m_j > r_j^0 \\ \mathbf{r}^0 & \text{if } \mathbf{m} > \mathbf{r}^0 \end{cases} \quad (11)$$

²⁰If there is no intervention by competition authority a with regard to patent i we can set $m_i^a \geq N^i(0)$, $a = A, B$, since this is formally equivalent to a non-binding regulation.

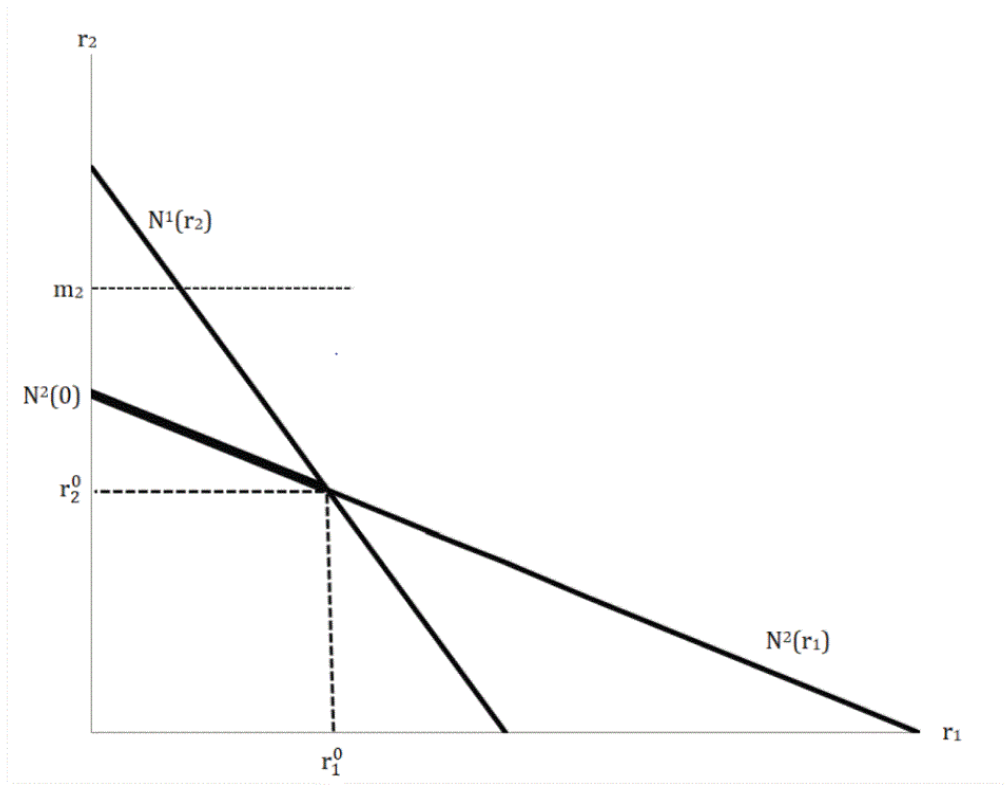


Figure 1: Implementable license fees with $r^0 < N^2(0) < m_2$

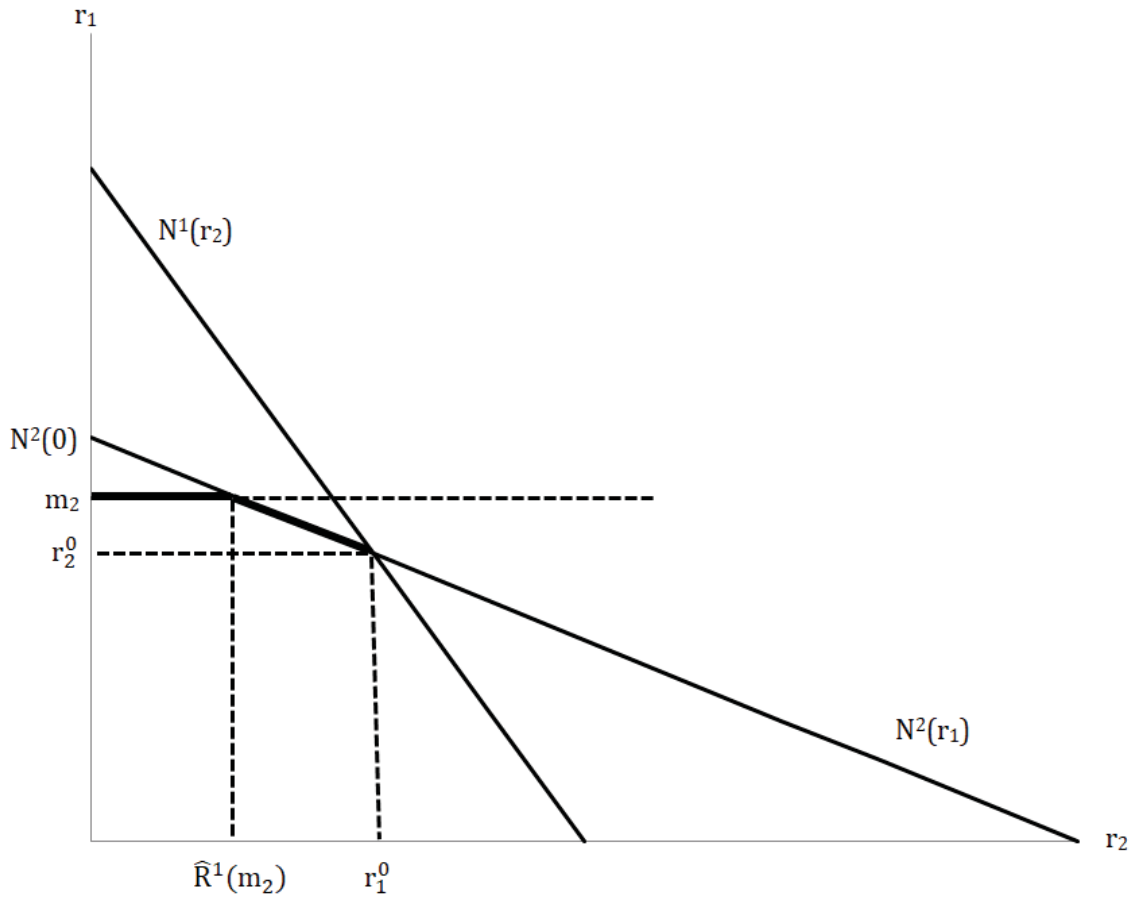


Figure 2: Implementable license fees with $r^0 < m_2 < N^2(0)$

3.4 Allocating jurisdiction over the SEPs according to the Default Rules

In what follows we will derive the outcome of the regulation by the competition authority or authorities, as the case may be, for each of the three bases for jurisdiction in the Default Rules that are of main relevance to SEPs: territoriality, nationality, and cross-border effects. And for each base we consider whether it is applicable to the acts, actors and objects involved.

Consider first the Territoriality Principle. The acts at issue in this context would be the behavior of SEP holders in the negotiations. We have not specified where the negotiation take place, however, partly since we want to leave open the nationality of the SEP holders. The actors involved are the SEP holders, but it is hard to see how the Territoriality Principle could be applied to these actors beyond the location of the acts that they commit. The objects at issue, the SEPs, have clear territorial features however, since the patents apply to the territory of country A, and only to this territory. We thus presume that an application of the Territoriality Principle gives country A jurisdiction over both SEPs.

Turning to the Nationality Principle, note first that acts do not seem to have nationality in any meaningful way, at least not here. But the actors obviously have nationality. The Nationality Principle would give jurisdiction to the home country of the respective SEP holder. We will allow for three different patterns of ownership of the SEPs: one where both holders are nationals of country A, one where they are both nationals of country B, and one where the holder of SEP 1 is a country A national and the holder of SEP 2 a national of country B. The objects, the patents, are issued by country A. The Nationality Principle could therefore also give jurisdiction to country A. But it seems plausible that the nationality of the actors should dominate from point of view of the Nationality Principle; at least this is what will be assumed.

Finally, there will be inherently conflicting claims when applying the Effects Principle, at least when interpreted literally, since the license fees affect both the producer and consumers. Starting with the acts, exploitation of market power by the SEP holders will directly affect the producer, providing an argument for CB to claim jurisdiction. But the resulting higher consumer price will harm consumers, giving CA a rationale for regulating. There will also be spill-over effects between the two bargaining processes, since a high r_i reduces the scope for a high r_j . If the SEPs holders have different nationalities, both authorities can point to effects as a reason for enforcing the FRAND commitment by the other country's SEP holder. Finally, it does not seem meaningful to identify either the actors or the objects—the SEPs—with effects other than those that stem from acts. We will thus interpret the Effect Principle to give both countries jurisdiction over both patents.²¹

Table 1 summarizes the reasoning above. "A1" is a short-hand for country A having (possibly overlapping) jurisdiction over SEP 1, etc., and "n.a." denotes constellations of jurisdictional bases and targets for regulation that do not appear to be meaningful in the context of SEPs. Bracketed

²¹It appears as if country B could at least in theory use the Passive-Nationality Principle to claim jurisdiction, pointing to the need to protect its producer, and the holder of SEP 2 if a country B national, against the adverse effects of a high r_1 .

allocations are assumed to be dominated by other allocations for the respective jurisdictional base. As can be seen, it is a fairly complex pattern that emerges:

Jurisdictional base	Regulated entities		
	Acts	Actors	Objects
Territoriality Principle	Location not specified	n.a.	A1,A2
Nationality Principle, split ownership	n.a.	A1,B2	[A1,A2]
Nationality Principle, both holders A nat'ls	n.a.	A1,A2	[A1,A2]
Nationality Principle, both holders B nat'ls	n.a.	B1,B2	[A1,A2]
Effects Principle	A1,A2,B1,B2	n.a.	n.a.

Table 1: Allocation of jurisdiction as suggested by the Default Rules

Put differently:

Observation 1 *The Default Rules points to, but does not unambiguously specify, the following allocation of jurisdiction:*

- (i) *The Territoriality Principle gives CA exclusive jurisdiction over both SEPs;*
- (ii) *The Nationality Principle gives each authority jurisdiction over its national SEPs holder(s);*
and
- (iii) *The Effects Principle gives both countries jurisdiction over both SEPs.*

Note that the pattern of ownership of the SEPs has two qualitatively different implications for the outcome. First, as we have just seen, it affects the *allocation of jurisdiction* that stems from applying the Nationality Principle (and possibly also the Effects Principle). Second, for each allocation of jurisdiction, it affects the *objective function(s)* of the regulating authority(-ies), and thereby the regulatory decisions that will be made.

4 The outcomes with the three main bases for jurisdiction

We are now prepared to address our main issue: the relative virtues of the different jurisdictional bases in the Default Rules. This section focuses on the case where the ownership of the SEPs is divided between the countries, with the holder of SEP 1 being a national of country A, and the SEP 2 holder being a country B national. In this setting CA is concerned with consumer welfare and the revenue of SEP holder 1, and CB focuses on the revenue of holder 2, and possibly also industry

profits ($\gamma \geq 0$). The objective functions of the competition authorities are thus:

$$\begin{aligned} V^A(\mathbf{r}) &\equiv U(\mathbf{r}) + \alpha L^1(\mathbf{r}) \\ V^B(\mathbf{r}) &\equiv \alpha L^2(\mathbf{r}) + \gamma \Pi(\mathbf{r}) \end{aligned}$$

4.1 The Territoriality Principle

Applying the Territoriality Principle to the SEPs suggests, as argued above, that CA should have exclusive jurisdiction over both SEPs. The problem facing CA is thus to solve

$$\max_{m_1, m_2} V^A(\mathbf{r}(\mathbf{m}))$$

with $\mathbf{r}(m)$ defined in (11).

CA's preferences with respect to r_2 is straightforward: the higher is r_2 , the higher is the price of the product, and the lower thus the consumer surplus and the revenue of patent holder 1:

$$\begin{aligned} V_2^A &= U_2 + \alpha L_2^1 \\ &= -DP_2 + \alpha r_1 D_p P_2 < 0, \end{aligned} \tag{12}$$

where $U_2 < 0$, and $L_2^A < 0$. Hence, CA prefers r_2 to be as low as possible. Since CA can implement $r_2 = 0$ without reducing its choice set with regard to r_1 , it will do so by setting $m_2 = 0$.

CA's preferences with regard to the implemented fee r_1 are more ambiguous, and partly depend on the magnitude of the parameter α . As with r_2 , the higher is r_1 , the lower is the consumer surplus. But CA is also concerned with the revenue of the holder of SEP 1, which requires a strictly positive r_1 :

$$V_1^A = -DP_1 + \alpha(D + r_1 D_p P_1) \geq 0. \tag{13}$$

The optimal regulation for SEP will in general depend on the weight on license revenues relative to consumer welfare in CA's preferences. For α sufficiently small consumer welfare interests will completely dominate, $V_1^A(0, 0) = U_1 + \alpha L_1^1 < 0$, and it will be optimal for CA to choose a maximally strict regulation of FRAND₁: $r_1 = m_1 = 0$. CA will prefer $0 < r_1 < N^1(0)$ for $\alpha > \alpha'$, given by

$$\begin{aligned} V_1^A(0, 0; \alpha') &\equiv [\alpha' - P_1(0, 0)]D \\ &= 0 \end{aligned} \tag{14}$$

A necessary and sufficient condition for CA to prefer a strictly positive r_1 is thus that $\alpha > P_1(0, 0)$. The optimal $r_1 > 0$ is then given by $V_1^A(r_1, 0) = 0$. With α increasing beyond α' it will eventually hit a value α'' such that

$$V_1^A(N^1(0), 0; \alpha'') \equiv 0 \tag{15}$$

This is the highest m_1 that CA can enforce. For any higher m_1 the implemented outcome will be $N^1(0)$. There will consequently be no point to intervene regarding FRAND₁ for CA when $\alpha > \alpha''$.

For the assumption $\mathbf{r}^J > 0$ to be fulfilled, it must hold that $V_1^A(\mathbf{r}^J) > 0$, since $V_1^B(\mathbf{r}^J) < 0$. This would be compatible with CA choosing the regulation $\mathbf{m} = 0$ if V_{12}^A is sufficiently positive. But such a setting seems less interesting, and we thus disregard this possibility. For instance, it cannot arise in the linear version of the model.

It is possible however to have an equilibrium where CA chooses a regulation $m'_1 < r^0$, with m'_1 given by

$$V_1^A(m_1, 0) = 0. \quad (16)$$

This solution requires $m_1 > r^J$. This follows from the fact that for given r_2 , CA's optimal r_1 must be larger than what is jointly efficient, since CA disregards the adverse effect of r_1 on the other country. Hence, it must be the case that CA's optimal response to $r_2 = 0$, m' given by (16), must exceed the jointly efficient r_1 given $r_2 = 0$. The latter value of r_1 must in turn exceed r_1^J by virtue of (8), since it implies that the two FOCs with regard to joint welfare maximization are negatively sloped in the (r_1, r_2) plane. It follows that CA will either choose a regulation $r^J < m_1 \leq r^0$ as an interior solution, or if CA prefers $r_1 > r^0$, CA abstains from regulating the FRAND commitment for SEP 1. In the latter case $r_1 = N^1(0)$.

Hence:

Lemma 2 *When SEP holder 1 is a country A national, and holder 2 is a national of country B, the possible outcomes are:*

- (i) $\mathbf{r} = (m_1, 0)$ with m_1 given by (16) for $\alpha' < \alpha < \alpha''$, with α' in turn given by (14) and α'' by (15); and
- (iii) $\mathbf{r} = (N^1(0), 0)$ for $\alpha > \alpha''$.

To see the nature of the inefficiency of this allocation of jurisdiction, evaluate the derivatives of the joint welfare function at the solution to (16) :

$$\begin{aligned} W_1(m_1, 0) &= V_1^B < 0 \\ W_2(m_1, 0) &= V_2^B(m_1, 0) \\ &= (\alpha - \gamma)D > 0 \end{aligned}$$

where the sign of the second inequality follows from $m_2 = 0$ and the assumption that $r_2^J > 0$ (which requires $\alpha > \gamma$). Consequently:

Proposition 1 *When the holder of SEP 1 is national of country A and the holder of SEP 2 is a national of country B, the Territoriality Principle yields too lenient enforcement of the FRAND commitment for SEP 1, and too stringent enforcement of that for SEP 2.*

4.2 The Nationality Principle

The natural implication of the Nationality Principle is that CA has exclusive jurisdiction over the FRAND commitment for SEP 1, and CB exclusive jurisdiction of that for SEP 2, as argued above. This setting is qualitatively different from the one where CA or CB has jurisdiction over both SEPs, since there will now be an *interaction between the nationally pursued regulations* in certain situations. This stems from the assumption that the competition authorities determine their regulations m_1 and m_2 before the negotiations over the fees take place. Consequently, each authority will be aware of the fact that the outcome of the regulation will be given $\mathbf{r}(\mathbf{m})$. This implies that a regulation $r_1 \leq m_1$ by CA will not only affect r_1 , but can in certain instances also affect r_2 .

The Nash equilibrium regulations is now be given by

$$\begin{aligned} \max_{m_1} V^A(\mathbf{r}(\mathbf{m})) \\ \max_{m_2} V^B(\mathbf{r}(\mathbf{m})); \end{aligned}$$

There are several types of Nash equilibria, depending on the preference functions of the competition authorities. We consider first symmetric, and then asymmetric, outcomes.

(i) $m_i = 0$. One potential outcome is that both authorities set their respective fee to its minimum level, $m_1^A = m_2^B = 0$, so $\mathbf{r} = (0, 0)$. This equilibrium would require that α is sufficiently small that $V_1^A(0, 0) < 0$ and $V_2^B(0, 0) < 0$. But this outcome is not compatible with the assumption that the jointly optimal outcome is strictly positive, $\mathbf{r}^J > 0$.

(ii) $0 < m_i < r^0$. A second possibility is that the competition authorities prefer positive license fees for their respective SEPs, but not higher fees than that both can be implemented: the equilibrium regulations would then be $0 < m_1 < r^0$ and $0 < m_2 < r^0$. Given that $m_2 < r^0$, it is not possible for CA to affect r_2 through its choice of m_1 , and conversely for CB. Hence, for $0 < \mathbf{m} < \mathbf{r}^0$ to be an equilibrium it is necessary and sufficient that

$$\begin{aligned} V_1^A(\mathbf{r}(\mathbf{m})) &= U_1 + \alpha L_1^1 \\ &= 0 \end{aligned} \tag{17}$$

and

$$\begin{aligned} V_2^B(\mathbf{r}(\mathbf{m})) &= \alpha L_2^2 + \gamma \Pi_2 \\ &= 0. \end{aligned} \tag{18}$$

This outcome requires that α is large enough to make both authorities prefer strictly positive fees, but low enough that the implementation constraints are not violated.²²

²²Necessary but not sufficient is that $\alpha > \max(P_1, \gamma)$. Sufficient would be e.g. that $\alpha > 1$ and CB is only concerned

(iii) $m_i = r^0$. A third possibility is that α is sufficiently large that neither competition authority can achieve its desirable fee due to the implementation constraint, and therefore abstains from regulating (or equivalently, sets $m_i = r^0$). This equilibrium arises when

$$\begin{aligned} V_1^A(\mathbf{r}^0) &> 0 \\ V_2^B(\mathbf{r}^0) &> 0 \end{aligned}$$

in which case the outcome is $\mathbf{r} = \mathbf{r}^0$.

(iv) $m_i < r^0 < m_j$. In the cases above neither FRAND regulation imposes a binding constraint on the negotiated fee that exceeds the unregulated level r^0 . But there are also outcomes that implement $r_i < r^0 < r_j$. These outcomes can have a special property. To illustrate, assume that γ is small, so that CB is only concerned with the revenue of SEP holder 2. In this case CB prefers $m_2 > N^2(0)$, but CB cannot implement its desired r_2 for any level of m_1 , since its preferred m_2 will exceed what the parties will negotiate, $N^2(m_1)$. This case is illustrated in Figure 1, where the two solid lines are the two bargaining outcomes $N^1(r_2)$ and $N^2(r_1)$, and where it is assumed that $m_2 > N^2(0)$. The outcome for any $m_1 \leq r^0$ will thus be $(m_1, N^2(m_1))$ by (11). Consequently, when choosing the level of m_1 , CA will not only take into account how the choice of m_1 affects r_1 , CA will also take into account *how m_1 affects the fee r_2* . The higher is m_1 , the lower will the negotiated r_2 be. Increasing m_1 will thus be attractive in that it will leave more surplus to be divided between the parties in the negotiation concerning SEP 1. CA will thus in terms of Figure 1 choose the point along the thick portion of the curve $N^2(r_1)$ that maximizes its welfare.

Observation 2 *When each competition authority regulates the FRAND commitment for a domestic SEP only, an authority can in certain cases use a lenient enforcement of its domestic FRAND commitment as a means of inducing a low negotiated fee for the foreign SEP.*²³

In the linear version of the model, this incentive is sufficiently strong that CA prefers to push down r_2 as far as is possible, resulting in $\mathbf{m} = \mathbf{r}^0$. As a consequence, the Nationality Principle does not affect the outcome in the linear version of the model.

The feature just described may, but need not, affect the equilibrium. It will definitely do so whenever it is optimal for CB to set $m'_2 > N^2(0)$, as was assumed above. In such a case, for m'_2 to be optimal for CB, CB should not want to deviate, for given m_1 , to some r_2 smaller than $N^2(m'_1)$:

$$\nexists m''_2 : V^B(m'_1, m''_2) \geq V^B(m'_1, N^2(m'_1)) \quad (19)$$

with license revenue ($\gamma = 0$).

²³This feature stems from the assumption the decisions by the two competition authorities are made prior to the negotiations over fees.

For m'_1 to be optimal for CA it is required that

$$\begin{aligned} \frac{dV^A(m'_1, N^2(m'_1))}{dm_1} &= V_1^A + V_2^A N_1^2 \\ &= 0 \end{aligned} \quad (20)$$

It follows from $V_2^A N_1^2 > 0$ that $V_1^A < 0$ in this equilibrium, so CA is then choosing to implement a higher m_1 than what would be optimal from the point of view of its implication for r_1 , to reduce r_2 .

The fact that m_1 affects r_2 for $m_1 \geq \hat{R}^1(m_2)$ but not for lower values yields a non-concavity in the objective function of CA at $m_1 = \hat{R}^1(m_2)$. As a consequence, there are two possible types of equilibria with $r^0 < m_2 < N^2(0)$, depending on whether $m_1 \geq \hat{R}^1(m_2)$ (as defined in (10)). One possibility is that the equilibrium is of the same type as in (20), that is, along the downward-sloping portion of the thick line in Figure 2. In this case the resulting fees will be $\mathbf{r} = (m_1, N^2(m_1))$ by (11). The other possibility is that the equilibrium is along the horizontal portion of the thick line. In this case there is an interior optimum $\mathbf{r} = (m_1, m_2)$ given by (17) and (18). The preferences of CA and CB will affect whether the equilibrium will be of the first or second type. For instance, for given m_2 , CA might prefer to set m_1 such that it implements CA's preferred r_1 as closely as possible. Alternatively, CA might be willing to accept a less well-targeted r_1 in order to push down r_2 .

Lemma 3 *When SEP holder 1 is a national of country A, and holder 2 is a national of country B, the possible implemented outcomes with the Nationality Principle are:*

- (i) $\mathbf{r} < \mathbf{r}^0$ with m being the solutions to (17) and (18);
- (ii) $r^0 < r_1 < \hat{R}^1(r_2)$ and $r^0 < r_2 < N^2(m_1)$, with (r_1, r_2) being given by respectively (17) and (18) (or with the roles of the two SEPs reversed);
- (iii) $\mathbf{r} = (r_1, N^2(r_1))$, with r_1 given by (20) (or with the roles of the two SEPs reversed).

Turning to efficiency properties, in the case where \mathbf{m} is determined by (17) and (18),

$$\begin{aligned} W_1(\mathbf{r}(\mathbf{m})) &= V_1^B(\mathbf{r}(\mathbf{m})) < 0 \\ W_2(\mathbf{r}(\mathbf{m})) &= V_2^A(\mathbf{r}(\mathbf{m})) < 0 \end{aligned}$$

It follows from $W_i(\mathbf{r}^J) = 0$ that $\mathbf{r}(\mathbf{m}) > \mathbf{r}^J$.

Finally, the case where $\mathbf{r} = (m_1, N^2(m_1))$ requires that $m_2 > r^0 > r^J$, so m_2 will clearly be too high from a joint welfare perspective. m_1 will also impose a too lenient restriction from a joint welfare perspective, since when setting m_1 , CA does not take into consideration the negative impact on the welfare of CB:

$$V_1^A(\mathbf{r}(\mathbf{m})) < \frac{d}{dm_1} V^A(\mathbf{r}(\mathbf{m})) = 0$$

It follows from

$$V_1^A(\mathbf{r}^J) = -V_1^B(\mathbf{r}^J) > 0$$

and the concavity of V^A , that $m_1 > r^J$, with m_1 given by (20).

Proposition 2 *The Nationality Principle yields too lax enforcement of both FRAND commitments when the SEP holders have different nationalities.*

4.3 The Effects Principle

A third base for jurisdiction is the Effects Principle. It is straightforward to see the implications it will have in our setting, As we saw above, CA prefers the license fee for the foreign-owned SEP 2 to be as low as possible, to maximize consumer surplus and the revenue of SEP holder 1. CB wants r_1 to be as small as possible to maximize the profit of the producer, as well as the revenue of the holder of patent 2. Consequently, since the more stringent of the regulations bind when they are overlapping, the implemented outcome is

$$\mathbf{r} = (m_1^B, m_2^A) = (0, 0)$$

There will thus be too stringent enforcement, since $\mathbf{r}^J > 0$.

Proposition 3 *The Effects Principle yields too strict enforcement of both FRAND commitments.*

4.4 Other ownership patterns for the SEPs

We have thus far assumed that the holders of the SEPs have different nationalities. This is both from a theory and a practical point of view the more interesting case. But some understanding of the forces at work in this can be had from considering two alternative structures, one where both SEPs are held by nationals of the country issuing the patents, and one where they are nationals of the other country.

4.4.1 SEPs holders are nationals of the country issuing the patents

When both SEPs are country A nationals, CA is concerned with consumer welfare as well as the revenue of the two SEP holders, while CB's only interest is the profit of its exporter to country A. The objective functions of the competition authorities are then

$$\begin{aligned} V^A(\mathbf{r}) &\equiv U(\mathbf{r}) + \alpha[L^1(\mathbf{r}) + L^2(\mathbf{r})] \\ V^B(\mathbf{r}) &\equiv \gamma\Pi(\mathbf{r}). \end{aligned}$$

In this case both the Territoriality and the Nationality Principle plausibly allocates jurisdiction over both SEPs to country A. To highlight the incentives for CA to regulate the FRAND commitments,

consider the impact of an exogenous increase in r_i on CA welfare:

$$V_i^A = -DP_i + \alpha[D + r_1 D_p P_i + r_2 D_p P_i] \geq 0 \quad (21)$$

Hence, an increase in r_i drives up the product price and thereby reduces consumer welfare, $U_i < 0$. The resulting lower demand tends to reduce the license revenue for both SEPs. But it also tends to increase the revenue for SEP i . Indeed, if $r_1 = r_2 = 0$ at the outset, a small increase in r_i will increase aggregate license revenue. The same considerations apply symmetrically to the other SEP, so CA will prefer $r_1 = r_2 = \hat{r}$ given by

$$V_i^A(\hat{\mathbf{r}}) = 0 \quad (22)$$

where $\hat{\mathbf{r}} \equiv (\hat{r}, \hat{r})$. CA will thus choose the regulation $\mathbf{m} = \hat{\mathbf{r}}$, provided that $\mathbf{m} \leq \mathbf{r}^0$, so that $\hat{\mathbf{r}}$ can be implemented. The assumption that the jointly efficient fee \mathbf{r}^J is interior ($0 < \mathbf{r}^J < \mathbf{r}^0$), and thus given by

$$V_i^A(\mathbf{r}^J) + \Pi_i(\mathbf{r}^J) = 0,$$

implies that

$$V_i^A(\mathbf{r}^J) > 0$$

That is, the optimal regulation for CA is $\mathbf{r}^J < \mathbf{m} = \hat{\mathbf{r}} \leq \mathbf{r}^0$.

Turning to the Effects Principle, since the country B exporter is adversely affected by the license fees of both country A SEPs, CB will set the lowest possible fees, implying that it will enforce $\mathbf{r} = (0, 0)$. The outcome of the Effects Principle will thus be the same as when the ownership of the SEP is shared between the countries, resulting in too stringent regulation of both FRAND commitments.

The above findings can be summarized as follows:

Proposition 4 *When both SEPs holders are nationals of country A both the Territoriality and the Nationality Principle yields too lenient enforcement of both FRAND commitments, while the Effects Principle results in too stringent regulation.*

4.4.2 SEPs holders are not nationals of the country issuing the patents

When both SEP holders are country B nationals, the CA and CB welfare functions are:

$$\begin{aligned} V^A(\mathbf{r}) &\equiv U(\mathbf{r}) \\ V^B(\mathbf{r}) &\equiv \alpha[L^1(\mathbf{r}) + L^2(\mathbf{r})] + \gamma\Pi(\mathbf{r}) \end{aligned}$$

The Territoriality Principle still suggests that CA should regulate. But in contrast to the previous case, CA will now only protect domestic consumer surplus. It will consequently impose the strictest possible FRAND terms on both SEP negotiations, that is, it will set $\mathbf{m} = (0, 0)$.

The Nationality Principle instead allocates jurisdiction over both SEPs to CB. It will now be CB that internalizes the interconnectedness of the two bargaining processes, and for this reason tends to impose relatively lenient restrictions. But CB will also take the impact on the producer into account (assuming $\gamma > 0$):

$$V_i^B = \alpha(D + r_1 D_p P_i + r_2 D_p P_i) - \gamma D$$

For α sufficiently small the producer welfare interest will completely dominate, and it will be optimal for CB to impose a maximally strict regulation of FRAND₁; $m_1 = m_2 = 0$. But the assumption that $\mathbf{r}^J > 0$ implies that

$$U_i(\mathbf{r}^J) + V_i^B(\mathbf{r}^J) = 0,$$

and thus, since $U_i < 0$, that

$$V_i^B(\mathbf{r}^J) > 0$$

That is, CB will choose a more lenient regulation than is jointly optimal, $\mathbf{r}^J < \mathbf{m} \leq \mathbf{r}^0$, since it disregards the adverse consequences for country A consumers from high fees.

Finally, if jurisdiction is based on the Effects Principle, the outcome would be the same as for the other two ownership patterns, $\mathbf{r} = (0, 0)$, yielding too strict enforcement of both FRAND commitments.

Proposition 5 *When neither SEPs holder is a national of the country issuing the patents:*

- (i) *The Territoriality and the Effects Principle yield too stringent enforcement of the FRAND commitments for both SEPs; and*
- (ii) *The Nationality Principle leads to too lenient regulation of the FRAND commitments for both SEPs.*

4.5 The relative performance of the three bases for jurisdiction

The previous sections have considered the outcome for different bases for jurisdiction, in several economic settings. The purpose of the analysis was to determine whether any of the jurisdictional bases could be said to yield a persistently better outcome. The findings above might appear somewhat bewildering in this regard, simple as the economic model is. But a couple of more general conclusions can be extracted:

- Corollary 1** (i) *When there is no overlap in jurisdiction, regulating countries will impose too lenient enforcement of its own SEPs, and too stringent regulation of the other country's SEP(s).*
- (ii) *Whenever jurisdiction is overlapping, there will be too stringent enforcement.*

Consequently, neither of the three basic bases for jurisdiction will implement the jointly efficient outcome. Intuitively, in order for the enforcement of FRAND commitments to be jointly efficient,

two conditions must normally be fulfilled: (i) the objective function to be maximized must reflect the interests of both CA and CB, and (ii) the full set of fees are under the command of this policy maker. When the ownership of the SEPs is split between the countries, the Territoriality Principle implies that requirement (ii) is fulfilled, since it allows country A to set both restrictions on the fees. But it has the drawback of only leading to the maximization of V^A . The Nationality Principle instead allows both objective functions to be maximized, thus fulfilling requirement (i), but it has the disadvantage of causing each of the maximizations be done with respect to one of the fees only. The specifics of the situation will determine which principle performs better.

The two basic principles can be ranked however in two extreme cases. First, if α is large enough that competition authorities effectively only care about the license revenues of their respective SEP holder, the interests of the authorities would directly conflict, since a higher license fee for one SEP reduces the negotiated fee for the other. Letting one authority decide on both fees, as should be the allocation of jurisdiction according to the Territoriality Principle, will then be very harmful to the interests of the other authority. On the other hand, when α is quite small, the two authorities' interests tend to become more aligned, since the prime objective for CA—consumer surplus—and the prime objective for CB—producer profit—both benefit from low fees. Hence, letting CA regulate both fees will then be less of a problem from CB's point of view. This relation can be seen in the linear version of the model, where the Territoriality Principle is more jointly efficient for lower values of α (despite the assumption $\gamma = 0$), and where the Nationality Principle dominates for larger values (although implementing the non-regulated outcome \mathbf{r}^0).

Formally, when both parties effectively maximize their own the revenues of their domestically-owned SEP, the Territoriality Principle (TP) yields the outcome

$$r_i^{TP} = \arg \max_{r_i} L^1(r_1, r_2)$$

while the Nationality Principle results in

$$r_i^{NP} = \arg \max_{r_i} L^i(r_1, r_2)$$

The latter will be better from a joint welfare point of view if:

$$W^{TP} = L^1(r_1^{TP}, 0) + L^2(r_1^{TP}, 0) < L^1(r_1^{NP}, r_2^{NP}) + L^2(r_1^{NP}, r_2^{NP}) = W^{NP}$$

This hence holds in the linear version of the model for sufficiently large α .

The failure of the three bases to achieve a jointly efficient outcome raises the question of whether they are actually harmful. Assuming that both competition authorities regulate both FRAND commitments absent the Default Rules, the answer is simple with regard to the Effects Principle, since it will yield the same result as when the Default Rules are not applied. More unclear is whether the other bases improves matters. But in the linear version of the model both the Territoriality

and Nationality Principles yield jointly more efficient outcomes than when both countries regulate both FRAND commitments, as with the Effects Principle. However, for larger α it will be more efficient if both competition authorities *refrain* from regulating any commitment than if they allocate jurisdiction according to the Territoriality Principle, and refraining from regulating would for any α yield the same joint welfare level as applying the Nationality Principle.

5 National Treatment

The jointly efficient outcome requires that the license fees are identical, due to the completely symmetric way in which they affect the producer, and joint welfare. But some of the inefficient outcomes that we established above involved more stringent enforcement of foreign-owned than domestically-owned SEPs. It appears as if this could potentially violate a *National Treatment obligation* in a trade agreement. For instance, the first part of the National Treatment provision in Art. 3 of the *Agreement on Trade-Related Aspects of Intellectual Property Rights* (TRIPS Agreement) reads:

1. Each Members shall accord to the nationals of other Members treatment no less favorably than that it accords it own nationals with regard to the protection of intellectual property, subject to the exceptions already provided in [various conventions].

Without pretending to have undertaken a legal analysis of the applicability of this provision to SEPs, we note that more stringent treatment of a foreign-owned than a domestically-owned SEP could prima facie be taken to amount to "less favorable treatment" of the foreign-owned intellectual property right. But regardless of the applicability of this particular National Treatment provision, it is of interest to examine whether a constraint on differential treatment of domestic and foreign SEPs could improve on the outcome, alone or in combination with one of the bases in the Default Rules. We will examine this in two settings, one where a "National Treatment" obligation applies to SEP regulations within an industry, and a second more far-reaching interpretation where it applies across industries.

5.1 National Treatment within an industry

For a National Treatment obligation to have a bite, it must simultaneously be case that the SEP holders have *different nationalities*, that the same competition authority regulates *both* SEPs, and that this authority treats the foreign-owned patent *less favorably* than the patent with a domestic holder. This situation cannot arise under the Nationality Principle in the one-industry setting above, since jurisdiction is then split between the two countries. But it can arise either if jurisdiction is awarded according to the Territoriality Principle to CA, according to the Effects Principle, or when no jurisdictional rule is followed—in each case provided that the ownership of the SEPs is divided between the countries. Assume therefore that the holder of SEP 1 is a country A national, and the

other holder a national of country B. A natural interpretation of a National Treatment restriction would then be a requirement for CA to set $m_1 = m_2$.²⁴

Consider first the case where the National Treatment provision is imposed in a situation where *no* jurisdictional principles are applied, and where therefore both competition authorities regulate both FRAND commitments (or alternatively where they do so by virtue of the Effects Principle). Each of the competition authorities will impose the most stringent possible regulation on the respective other country's SEP, resulting in the outcome $\mathbf{r} = (0, 0)$. Their regulations will be discriminatory, so a strict National Treatment provision that requests each authority to impose the same regulation on both SEPs will affect the outcome.²⁵ The resulting outcome will be the lower of the common levels m^A and m^B chosen by the respective competition authority, provided that it is low enough to be implementable.

For instance, suppose that CA sets the more stringent regulation; the mechanism will be the same if it is instead CB that sets the more stringent regulation. CA's optimal regulation will be given by $\mathbf{m}^A \equiv (m^A, m^A)$, with

$$\begin{aligned} V_1^A(\mathbf{m}^A) + V_2^A(\mathbf{m}^A) &= U_1 + U_2 + \alpha(L_1^1 + L_2^1) \\ &= 0, \end{aligned}$$

provided \mathbf{m}^A is implementable (and disregarding corner solutions). m^A will thus be higher, the higher is α . Using this expression to evaluate the FOC for the jointly optimal fees (9) at \mathbf{m}^A we get:

$$\begin{aligned} W_i(\mathbf{m}^A) &= V_i^A(\mathbf{m}^A) + V_i^B(\mathbf{m}^A) \\ &= -V_j^A(\mathbf{m}^A) + V_i^B(\mathbf{m}^A) \\ &= (P_j - \gamma)D \end{aligned}$$

Hence, a strict National Treatment provision could implement the jointly efficient regulation by a pure coincidence—if $P_j = \gamma$. If instead $P_i > \gamma$, it follows from $W_i(\mathbf{m}^A) > 0$ that $\mathbf{r}^J > \mathbf{m}^A$. There will thus then be *too stringent enforcement* with the National Treatment provision, so the fully efficient outcome is not implemented. But the imposition of a National Treatment obligation will still unambiguously *improve joint welfare*, since it will then hold that $(0, 0) < \mathbf{m}^A < \mathbf{r}^J$. The imposition of the strict National Treatment provision can also increase welfare if $P_j < \gamma$ so that it implements $\mathbf{m}^A > \mathbf{r}^J$. But there does not seem to be any guarantee that this will be the case, as long as the unregulated outcome \mathbf{r}^0 can yield less joint welfare than $\mathbf{r} = (0, 0)$, the outcome when

²⁴Since we are assuming that CA sets a more stringent restriction on the license fee for the foreign SEP absent a National Treatment obligation, we disregard that National Treatment provisions normally are in the form of weak inequalities, such as "treatment no less favorable than..."

²⁵A natural interpretation of a National Treatment restriction would then be a requirement for CA not to impose a regulation with $m_1 \geq m_2$.

both competition authorities regulate.

Assume next that the National Treatment obligation is imposed in a situation where jurisdiction is allocated to CA according to the Territoriality Provision. Absent the obligation, CA would choose $m'_1 < r^0$ and $m'_2 = 0$ such that

$$\begin{aligned} V_1^A(m'_1, 0) &= 0 \\ V_2^A(m'_1, 0) &\leq 0. \end{aligned}$$

and the difference in the regulated levels would thus be $m_1 - m_2 = m'_1$. To see the effect of a National Treatment provision, consider the imposition of a provision that only requests CA to reduce this gap with a marginal amount. To abide by the rule, CA could either make both restrictions more lenient, while letting m_2 increase more than m_1 . Alternatively, CA could reduce m_1 , while maintaining m_2 constant. A reduction change in m_1 will not have any first-order effect at $(m'_1, 0)$ since $V_1^A(m'_1, 0) = 0$. But an increase in m_2 will have a negative first-order effect equal to $(-D + \alpha r' D_p) P_2 < 0$. Hence, CA's optimal adjustment to this slightly binding National Treatment rule would be to reduce m_1 , while maintaining m_2 constant. As the rule is gradually further tightened, it will eventually be optimal for CA to set $m_2 > 0$. And with a strict National Treatment rule, requesting equal regulation of the two FRAND commitments, CA will set $0 < m_1 = m_2 < m'_1$.

The imposition of a marginally binding National Treatment rule will be desirable from a joint welfare perspective. But there is no guarantee that joint welfare increases with the imposition of *strict* National Treatment, since the changes are then non-marginal. Indeed, in the linear version of the model with CA exclusively regulating both FRAND commitments with and without the National Treatment provision, the imposition of this obligation will *reduce* joint welfare for the relevant range of α . That is, in that setting it is preferable from a joint welfare perspective to allow CA to discriminate between the two SEPs.

To summarize:

Proposition 6 *With the Territoriality Principle applied to discriminatory treatment within an industry in which the ownership of the patents is split between the countries:*

- (1) *The imposition of a marginally binding National Treatment provision will improve joint welfare; and*
- (2) *The imposition of a strict National Treatment provision has ambiguous implications for joint welfare, if the patent-issuing country has exclusive jurisdiction over both SEPs.*

5.2 National Treatment across industries

A National Treatment obligation would not have any bite with jurisdiction based on the Nationality Principle in the economic framework we have used so far, for the simple reason that each competition authority then regulates only one SEP. But a National Treatment obligation could have a bite also

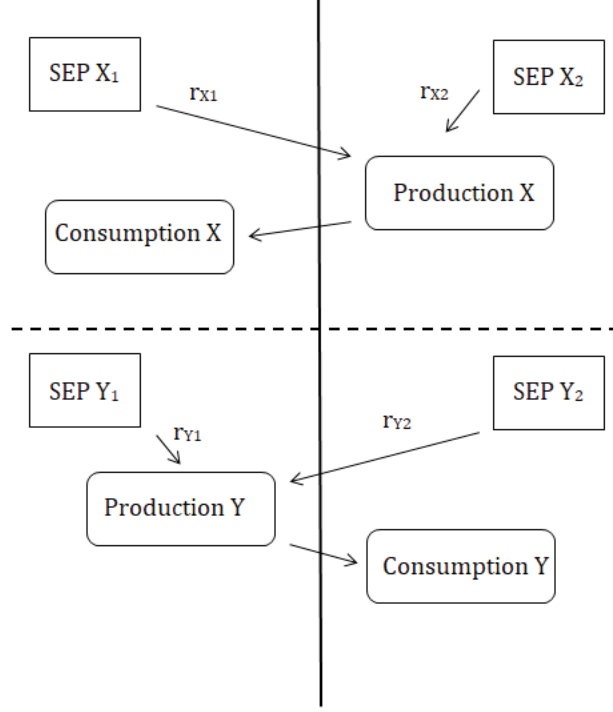


Figure 3: Production pattern with two industries

when jurisdiction is allocated according to the Nationality Principle, in more general economic settings. To illustrate in the simplest possible fashion, assume that there are two industries X and Y. Industry X is identical to the one examined above. Industry Y is a mirror image with the roles of the countries reversed; see Figure 3 for an illustration.

In industry X production draws on two SEPs, the country A-owned X1 and the country B-owned X2, and production in industry Y uses the country A-owned Y1 and the country B-owned Y2. With $\mathbf{r}_X \equiv (r_{X1}, r_{X2})$ and $\mathbf{r}_Y \equiv (r_{Y1}, r_{Y2})$, the objective functions for CA for the two sectors are:

$$V^{AX}(\mathbf{r}_X) \equiv U^X(\mathbf{r}_X) + \alpha L^{X1}(\mathbf{r}_X) \quad (23)$$

$$V^{AY}(\mathbf{r}_Y) \equiv \alpha L^{1Y}(\mathbf{r}_Y) + \gamma \Pi^Y(\mathbf{r}_Y). \quad (24)$$

and the corresponding expressions for CB are:

$$V^{BX}(\mathbf{r}_X) \equiv \alpha L^{X2}(\mathbf{r}_X) + \gamma \Pi^X(\mathbf{r}_X) \quad (25)$$

$$V^{BY}(\mathbf{r}_Y) \equiv U^Y(\mathbf{r}_Y) + \alpha L^{2Y}(\mathbf{r}_Y) \quad (26)$$

Assuming that the industries are economically completely separated, the jointly efficient outcome is the solution to

$$\max_{r_{X1}, r_{X2}} V^{AX}(\mathbf{r}_X) + V^{BX}(\mathbf{r}_X) \quad (27)$$

$$\max_{r_{Y1}, r_{Y2}} V^{AY}(\mathbf{r}_Y) + V^{BY}(\mathbf{r}_Y) \quad (28)$$

if unconstrained by the implementation constraints.

With jurisdiction allocated according to the Nationality Principle, CA now regulates FRAND commitments for SEPs X1 and Y1, and CB those for SEPs X2 and Y2. Absent a National Treatment obligation, CA would here set m_{X1} identically to how country A chooses m_1 in Section 4.2, and it would set m_{Y1} as country B sets m_2 in that section. So the regulations for each of the markets are $\mathbf{m}_X \equiv (m_{X1}, m_{X2})$ and $\mathbf{m}_Y \equiv (m_{Y1}, m_{Y2})$. With $\mathbf{r}_X(\mathbf{m}_X)$ defined as in (11), and $\mathbf{r}_Y(\mathbf{m}_Y)$ in symmetric fashion, country A would thus solve the problem

$$\max_{m_{X1}, m_{Y1}} V^{AX}(\mathbf{r}_X(\mathbf{m}_X)) + V^{AY}(\mathbf{r}_Y(\mathbf{m}_Y)) \quad (29)$$

and CB would solve a symmetric problem.

There are several possible equilibrium constellations in this case, as was summarized in Lemma 3. Consider the case where α is sufficiently large that each competition authority thus *regulates the SEP that is used by the foreign producer less stringently than the SEP that is used by its domestic producer for exports*. For simplicity, assume that the outcome is $r_{X1} = N^1(0)$ and $r_{X2} = 0$, and $r_{Y1} = 0$ and $r_{Y2} = N^2(0)$.

There is no differential treatment of foreign-owned and domestically-owned SEPs within either industry. But the consequence of the FRAND enforcement is still to discriminate between domestic and foreign interests, albeit in different industries; $r_{X1} > r_{Y1} = 0$ and $r_{Y2} > r_{X2} = 0$. Consider therefore the imposition of a National Treatment-like provision that requires each regulating country to choose the *same FRAND terms for all of its domestic patents*, regardless of ownership or where they are used for production and consumption. Each country would now impose the same regulation throughout its economy. CA would choose $m^A = m_{X1} = m_{Y1}$, and CB would choose $m^B = m_{X2} = m_{Y2}$, so as to:

$$\begin{aligned} \max_{m^A} V^{AX}(\mathbf{r}_X(m^A, m^B)) + V^{AY}(\mathbf{r}_Y(m^A, m^B)) \\ \max_{m^B} V^{BX}(\mathbf{r}_X(m^A, m^B)) + V^{BY}(\mathbf{r}_Y(m^A, m^B)) \end{aligned} \quad (30)$$

Due to the symmetry of the industries, $V^{AY}(r_{Y1}, r_{Y2}) \equiv V^{BX}(r_{X1}, r_{X2})$. So each competition authority effectively chooses its regulation to maximize joint welfare—the solution to (30) will be the same as the solution to (27)—implying that this National Treatment obligation in this special case with complete symmetry *implements the jointly efficient outcome*. Intuitively, absent

the National Treatment provision the two industries are economically separate, implying that CA's decision problem for industry X is fully separate from its problem for industry Y. But the obligation ties together the two decision problems. Of course, each authority still disregards the impact of its decision for the other country. But with the obligation each authority will take into account the effects of its decision both with regard to the industry where it is an importer and where it is an exporter. When the countries are mirror images each competition authority will effectively maximize welfare with respect to the instrument it controls for an economy that is a replica of the other country.

Finally, in case the Effects Principle is used to allocate jurisdiction (or if there are no rules governing jurisdiction), the National Treatment provision would request each competition authority to set one regulation for all four SEPs. But the increase in the number of commitments that each authority regulates will not affect the outcome, since the authorities are still constrained by the National Treatment obligation to choose one level only, and the objectives functions of the authorities remain the same.

Proposition 7 *A National Treatment obligation that applies across industries can implement the jointly efficient outcome if countries are fully symmetric, when countries are unconstrained by jurisdictional rules, or allocate jurisdiction according to the Nationality Principle or the Effects Principle.*

6 Concluding discussion

It is becoming increasingly common for competition authorities to regulate the implementation of FRAND commitments. The authorities do not find much guidance in the vague formal texts of the FRAND commitments for the interpretation of whether SEP holders request too much for making their technologies available to implementers. The authorities instead (implicitly or explicitly) have to balance the two societal goals of providing incentives for innovators to develop new technologies, and of making the technologies accessible to implementers at low cost.

The interpretation of FRAND commitments are very of concern to more than one country. This raises question *which* national competition authority should regulate? There is no multilateral agreement on the enforcement of the FRAND commitments for SEPs. At the same time, the allocation of the jurisdiction over the enforcement of the FRAND commitments might differ both due to differences in regulatory philosophies, and—as has been the focus of this paper—due to *competition authorities' pursuit of national objectives*.

The purpose of the paper is to shed some light on the economic performance of three main bases for jurisdiction that are identified in the Default Rules for jurisdiction in customary international law, which bind all nations absent international agreements: the Territoriality Principles, Nationality Principle, and the Effects Principle. These principles are well-established in international law, stemming from many years of interaction between states in a large number of different areas. They

apply also to the regulation of FRAND commitments. Little is known about the appropriateness of these rules from an economic point of view, however. To the best of our knowledge, this is the first paper to compare the economic performance of these rules for allocating jurisdiction over the regulation of FRAND commitments for SEPs.

The analysis rests on the assumption that national competition authorities pursue nationally defined objectives that disregard to the interests of other competition authorities. The allocation of jurisdiction over SEPs will therefore typically affect implemented regulations. To capture implications of allocating jurisdiction according to the Default Rules, and to determine whether any of the principles performs better from a joint welfare perspective, the paper employs the simplest possible model of an industry in which holders of SEPs negotiate license terms with a producer, and where two countries are involved in different parts of a production chain. The focus is mainly on the Territoriality and Nationality Principles. The Effects Principle, at least in its most extreme form, imposes no limits on jurisdiction. This follows trivially from the fact that in an economic model, any policy decision will typically affect all objective functions. So strictly interpreted, the Effects Principle does not limit the exercise of jurisdiction. But both the Territoriality and the Nationality Principles have more potential to limit the jurisdictional reach of the countries. It is not a foregone conclusion that they will have such effect, however. Each principle may give different conclusions with regard to jurisdiction depending on whether it is applied to acts, actors or objects. But we have argued that it seems plausible that the Territoriality Principle give jurisdiction to the country that issues the patents in question, while the Nationality Principle allocates jurisdiction according to the nationalities of the SEP holders.

A general negative finding is that neither of the Default Rules implements a jointly efficient outcome. A basic shortcoming of the rules is that they do not induce regulating countries to internalize the consequences of their decisions, but *only select the country (or countries) that can impose its desired regulation on the SEPs*. The nature of the inefficiencies are summarized in Table 2:

	Both SEPs A-owned	Split ownership	Both SEPs B-owned
Territoriality Principle	$m_i > r^J$	$m_1 > r^J, m_2 < r^J$	$m_i < r^J$
Nationality Principle	$m_i > r^J$	$m_i > r^J$	$m_i > r^J$
Effects Principle	$m_i < r^J$	$m_i < r^J$	$m_i < r^J$

Table 2: The efficiency properties of the three jurisdictional bases

Hence, the Nationality Principle consistently yields too lenient enforcement of FRAND commitments, while the Effects Principle has the opposite implications. The Territoriality Principle gives jurisdiction to the country that has issued the patents, and the inefficiency that results from this depends on the distribution of the ownership of the SEP across countries. SEPs that are domestically-

owned by the issuing country will be enforced too leniently, and conversely for foreign-owned patents. Intuitively, when the ownership of the SEPs is split between the countries, the Territoriality Principle has the virtue of allowing the same competition authority jurisdiction over both FRAND commitments. But this authority will use this power to maximize its own welfare only, and the resulting externalities will prevent the outcome from being jointly efficient. With jurisdiction allocated according to the Nationality Principle, there is no coordination between the choices of the regulations, since each competition authority has jurisdiction over one of the patents. But on the other hand, both objective functions are taken into consideration in the determination of the outcome.

The straightforward pattern that emerges from these findings is hence:

- Regulating countries will impose too lenient enforcement of its own SEPs, and too stringent regulation of the other country's SEP(s), when there is no overlap in jurisdiction; and
- There will be too stringent enforcement whenever jurisdiction is overlapping.

Another general and negative finding is that there seems to be *no clear hierarchy among the jurisdictional bases* from an economic efficiency perspective. Indeed, there is no clear hierarchy even in the linear version of the model, where the weight α that competition authorities attach to SEP license revenues is the sole parameter through which different outcomes can be generated. This finding can perhaps be said to support the lack of such a hierarchy in international law.²⁶

Finally, since the Default Rules will not suffice to implement an efficient outcome, it is natural to look for a negotiated solution to the international externality problems with FRAND enforcement. One possibility would be to form an agreement that *only specifies the allocation of jurisdiction*, that is, an agreement that only specifies a hierarchy among the bases in the Default Rules. As we have seen above, such an agreement would have to specify different jurisdictional bases depending on the particular circumstances at hand, and would thus be difficult to draft.

An alternative would be to form a *comity agreement* that delegates jurisdiction to the party with greater interest in regulating. Such agreements exist in other areas of competition policy, but are rare, and comity is also sometimes part of domestic law. But apart from having to address the tricky question of how to measure "greater interest", a comity agreement has the drawback of allocating jurisdiction to the party with the larger unilateral interest, not to the party that will implement the higher joint welfare. There are therefore limits to the extent to which it can improve the outcome.

A step toward more directly affecting the level of regulation would be to include a *National Treatment* obligation in an agreement that allocates jurisdiction. As we saw above, a National

²⁶It has been assumed throughout that the regulation that maximizes joint welfare allows for strictly positive fees, but is more stringent than the outcome absent policy intervention. If the efficient outcome were instead given by a corner solution, one of the jurisdictional bases might be optimal; for instance, if the efficient outcome is the strictest possible regulation $\bar{\mathbf{r}} = (0, 0)$, allocating jurisdiction according to the Effects Principle would implement the efficient outcome. But these corner solutions do not seem to be relevant from a practical point of view.

Treatment provision will not have any bite if applied within an industry when jurisdiction is allocated according to the Nationality Principle. But it can affect the outcome when either of the Territoriality Principle or the Effects Principle prevails. It appears as if a National Treatment obligation would have the largest likelihood of improving the outcome in cases where there are no rules governing jurisdiction.

An even more ambitious solution would be to negotiate an international agreement on the *level of FRAND enforcement* for any intervention. This agreement need not specify the allocation of jurisdiction, other than perhaps to coordinate the interventions between the two authorities. But it again appears very difficult to draft such an agreement in practice.

To conclude, a rather negative picture emerges from the analysis and discussion above: A very large number of SEPs are of central concern internationally. The existing legal framework for allocating jurisdiction over the enforcement of FRAND commitments for these SEPs will most likely not implement economically efficient outcomes. It also appears very difficult to draft international agreements to effectively address these problems.

A Appendix: A linear version of the model with split ownership

This Appendix employs the simplest possible linear version of the model above to verify the existence of certain outcomes. It considers the case where the holder of SEP 1 is a national of country A, and the holder of SEP 2 a country B national.

Consider first the product market competition stage. Let gross consumer welfare be

$$\tilde{U}(c) \equiv c - \frac{1}{2}c^2 + y,$$

where $0 < c < 1$ is consumption of the product of interest, and y is consumption of other products. The associated demand is

$$D(p) = 1 - p > 0 \text{ for } p < 1,$$

where $0 < p < 1$ is the price of the product.

For given license fees $r_i < \frac{1}{2}$, the optimal producer price is given by

$$\begin{aligned} P(\mathbf{r}) &\equiv \arg \max_p (p - r_1 - r_2)(1 - p) \\ &= \frac{1}{2} (1 + r_1 + r_2). \end{aligned}$$

since the SOC is always fulfilled. Equilibrium consumption thus

$$c = \frac{1}{2} (1 - r_1 - r_2) > 0.$$

Disregarding the income term, the maximized consumer welfare is

$$U(\mathbf{r}) = \frac{1}{8} (1 - r_1 + r_2)^2,$$

the maximized profit is

$$\Pi(\mathbf{r}) = \frac{1}{4} (1 - r_1 - r_2)^2,$$

and license revenues are

$$\begin{aligned} L^i(\mathbf{r}) &\equiv r_i D(P(r_1, r_2)) \\ &= \frac{1}{2} r_i (1 - r_1 - r_2). \end{aligned}$$

A.1 Bargaining over license fees absent FRAND enforcement

The simultaneous negotiation over license fees yields the outcome given by

$$\begin{aligned}\frac{d}{dr_1}[L^1(\mathbf{r})\Pi(\mathbf{r})] &= 0, \\ \frac{d}{dr_2}[L^2(\mathbf{r})\Pi(\mathbf{r})] &= 0.\end{aligned}$$

The SOC's are of the form

$$\frac{d^2}{dr_i^2}[L^i(\mathbf{r})\Pi(\mathbf{r})] = -\frac{3}{4}(1 - 2r_1 - r_2)(1 - r_1 - r_2),$$

and are thus fulfilled for $r_i < \frac{1}{3}$ as will be the case in what follows.

Consider the negotiation over r_1 , say. There are two solutions to the bargaining problem above: $r_1 = 1 - r_2$ and $r_1 = \frac{1}{4} - \frac{1}{4}r_2$. The former implies the maximized Nash product equals 0, and the latter that it is strictly positive. Due to symmetry, the same applies identically to the negotiation over r_2 . Hence the best reply functions for the two negotiations are

$$N^i(r_j) = \frac{1}{4}(1 - r_j).$$

It follows that

$$\left.\frac{dr_2}{dr_1}\right|_{N^1} = -4 < \left.\frac{dr_2}{dr_1}\right|_{N^2} = -\frac{1}{4} < 0,$$

and that the market outcome with no FRAND enforcement is

$$\mathbf{r}^0 = \left(\frac{1}{5}, \frac{1}{5}\right).$$

A.2 Competition authorities

Assuming that CB disregards the profits of its producer, the objective function for the competition authorities are

$$V^A(\mathbf{r}) \equiv U(\mathbf{r}) + \alpha L_1(\mathbf{r}),$$

$$V^B(\mathbf{r}) \equiv \alpha L_2(\mathbf{r}),$$

and joint welfare is

$$W(\mathbf{r}) \equiv V^A(\mathbf{r}) + V^B(\mathbf{r}).$$

The joint welfare fulfills assumption (8) since

$$W_{12} = \frac{1}{4} - \alpha,$$

which is negative for the relevant range of α (as will be seen).

Consider the jointly efficient fees. Due to the symmetry, $r_1 = r_2 = r$. The SOC for joint efficiency maximization is fulfilled iff $\alpha < \frac{1}{4}$:

$$W_{ii} = 1 - 4\alpha.$$

Since W is convex for $\alpha < \frac{1}{4}$, the solution is either $r = 0$ or $r = \frac{1}{2}$ (the maximal feasible r), yielding respectively $W = \frac{1}{8}$ and $W = 0$, so $r_i^J = 0$ is jointly optimal in this case. For $\alpha > \frac{1}{4}$ there will be an interior solution to the FOC $W_1 = 0$, given by

$$r = \frac{1}{4} \left(\frac{\alpha - \frac{1}{2}}{\alpha - \frac{1}{4}} \right).$$

This is negative for $\frac{1}{4} < \alpha < \frac{1}{2}$, implying $r^J = 0$ again. Finally, for $\frac{1}{2} < \alpha$, the outcome that maximizes W is given by the interior solution.

Assuming that the jointly optimal fees must respect the implementation constraint, $r \leq r^0$, the jointly optimal fees are:

$$r^J = \begin{cases} 0 & \text{if } \alpha \leq \frac{1}{2}, \\ \frac{1}{4} \frac{\alpha - \frac{1}{2}}{\alpha - \frac{1}{4}} & \text{if } \frac{1}{2} < \alpha \leq \frac{3}{2}, \\ \frac{1}{5} & \text{if } \frac{3}{2} < \alpha. \end{cases}$$

The paper assumes throughout that $0 < \mathbf{r}^J < \mathbf{r}^0$. This here corresponds to assuming that $\frac{1}{2} < \alpha < \frac{3}{2}$, which will be presumed to be fulfilled in what follows. The resulting maximal joint welfare level is:

$$W^J = \frac{\alpha^2}{8\alpha - 2}$$

The joint welfare resulting with no FRAND enforcement, in which case $r^0 = \frac{1}{5}$, is

$$W^0 = \frac{3}{25}\alpha + \frac{9}{200} < W^J.$$

A.3 Outcomes as a function of the allocation of jurisdiction

A.3.1 CA has exclusive jurisdiction over both licenses

CA prefers $r_2 = 0$ regardless of r_1 :

$$V_2^A = -\frac{1}{4}(1 - r_1 - r_2 + 2\alpha r_1) < 0$$

V^A is strictly concave in r_1 (for the assumed range for α):

$$V_{11}^A = \frac{1}{4} - \alpha$$

The interior solution to the FOC with respect to r_1 is

$$r_1 = \frac{1}{2} \frac{\alpha - \frac{1}{2}}{\alpha - \frac{1}{4}} \begin{cases} < \frac{1}{2} \\ > 0 \end{cases}.$$

CA can implement $m_2 = 0$, but cannot enforce higher r_1 than what the negotiation gives, which for $m_2 = 0$ is $N^1(0) = \frac{1}{4}$. Hence, the critical value of α for which the implementation constraint starts to bite is given by

$$\frac{1}{2} \frac{\alpha - \frac{1}{2}}{\alpha - \frac{1}{4}} = \frac{1}{4},$$

or $\alpha = \frac{3}{4}$. The outcome is thus

$$\begin{aligned} r_1^{TP} &= \begin{cases} \frac{1}{2} \frac{\alpha - \frac{1}{2}}{\alpha - \frac{1}{4}} & \text{if } \frac{1}{2} < \alpha \leq \frac{3}{4}, \\ \frac{1}{4} & \text{if } \frac{3}{4} < \alpha < \frac{3}{2}, \end{cases} \\ r_2^{TP} &= 0. \end{aligned}$$

The resulting joint welfare will be

$$W^{TP} = \begin{cases} \frac{\alpha^2}{8\alpha-2} & \text{if } \frac{1}{2} < \alpha \leq \frac{3}{4}, \\ \frac{3}{32}\alpha + \frac{9}{128} & \text{if } \frac{3}{4} < \alpha < \frac{3}{2}. \end{cases}$$

A.3.2 CA exercises jurisdiction over patent 1, CB over patent 2

Applying Lemma (11) to the present setting yields the implemented fees

$$\mathbf{r}(\mathbf{m}) = \begin{cases} \mathbf{m} & \text{if } \mathbf{m} < (\frac{1}{5}, \frac{1}{5}) \\ (m_1, \min(m_2, N^2(m_1))) & \text{if } m_1 < \frac{1}{5} \text{ and } m_2 > \frac{1}{5} \\ (\min(m_1, N^1(m_2)), m_2) & \text{if } m_1 > \frac{1}{5} \text{ and } m_2 < \frac{1}{5} \\ \mathbf{r}^0 & \text{if } \mathbf{m} > (\frac{1}{5}, \frac{1}{5}) \end{cases}$$

It was seen above that V^A is strictly concave in r_1 . V^B is also strictly concave in r_2 :

$$V_{22}^B = -\alpha$$

We can also confirm that $V_{12}^A < 0$, in line with what is assumed in Section 4.1:

$$\begin{aligned} V_{12}^A &= \frac{1}{4} (1 - 2\alpha) \\ V_{12}^B &= -\frac{1}{2}\alpha \end{aligned}$$

Disregarding the implementation constraint, the two FOCs

$$\begin{aligned} V_1^A &= 0 \\ V_1^B &= 0 \end{aligned}$$

yield a candidate for a Nash equilibrium with both FOCs fulfilled as interior solutions:

$$\begin{aligned} r_1 &= \frac{2\alpha - 1}{6\alpha - 1} \\ r_2 &= \frac{2\alpha}{6\alpha - 1} \end{aligned} \tag{A.1}$$

But since the maximal implementable $r_2 = N^2(0) = \frac{1}{4}$, and the above solution implies $r_2 > \frac{1}{3}$, there cannot be an equilibrium of this type.

The other alternative is that $r_2 = N^2(r_1)$. The optimal choice of m_1 will then maximize $V^A(r_1, N^2(r_1))$ subject to the implementation constraint $m_1 = r_1 \leq r^0$. V^A is strictly concave in r_1 since

$$V_{11}^A = \frac{3}{64} (3 - 16\alpha)$$

is negative in the relevant range. There will not be an interior solution to CA's problem however, since evaluated at the maximal permitted value $r_1 = \frac{1}{5}$,

$$V_1^A = \frac{9}{80} (2\alpha - 1) > 0.$$

Consequently, the Nationality Principle has no bite in this case:

$$r_1^{NP} = r_2^{NP} = \frac{1}{5}$$

The resulting welfare is

$$W^{NP} = \frac{9}{200} + \frac{3}{25}\alpha$$

Intuitively, the temptation for CA to drive down r_2 through a lenient enforcement of the FRAND commitment for its domestic SEP will be sufficiently strong for CA to implement the maximal feasible r_1 .

A.3.3 Both authorities exercise jurisdiction over both patents

With $m_i = 0$, the outcome will be $\mathbf{r} = (0, 0)$, resulting in welfare

$$W^{EP} = \frac{1}{8}.$$

A.3.4 National Treatment within an industry

Suppose CA has jurisdiction over both SEPs (by virtue of the Territoriality Principle), but is constrained by a National Treatment provision requesting $r_2 = r_1$. The problem facing CA is thus

$$\begin{aligned} \max_r V^A(r, r) \\ \text{s.t. } r \leq r^0 \end{aligned}$$

V^A is strictly concave in r :

$$\frac{d^2}{dr^2} V^A(r, r) = 1 - 2\alpha$$

The interior solution to the FOC

$$\frac{d}{dr} V^A(r, r) = 0$$

is

$$r = \frac{\alpha - 1}{4\alpha - 2}$$

However, this is negative for $\frac{1}{2} < \alpha < 1$, so $m^{NT} = r = 0$ for this range. At the maximally allowed $\alpha = \frac{3}{2}$ the license common license fee is $r^{NT} = \frac{1}{8}$.

In sum:

$$r^{NT} = \begin{cases} 0 & \text{if } \frac{1}{2} < \alpha \leq 1 \\ \frac{\alpha-1}{4\alpha-2} & \text{if } 1 < \alpha \leq \frac{3}{2} \end{cases}$$

with the resulting welfare

$$W^{NT} = \begin{cases} \frac{1}{8} & \text{if } \frac{1}{2} < \alpha \leq 1 \\ \frac{1}{8} \frac{(4\alpha-3)\alpha^2}{(2\alpha-1)^2} & \text{if } 1 < \alpha \leq \frac{3}{2} \end{cases}$$

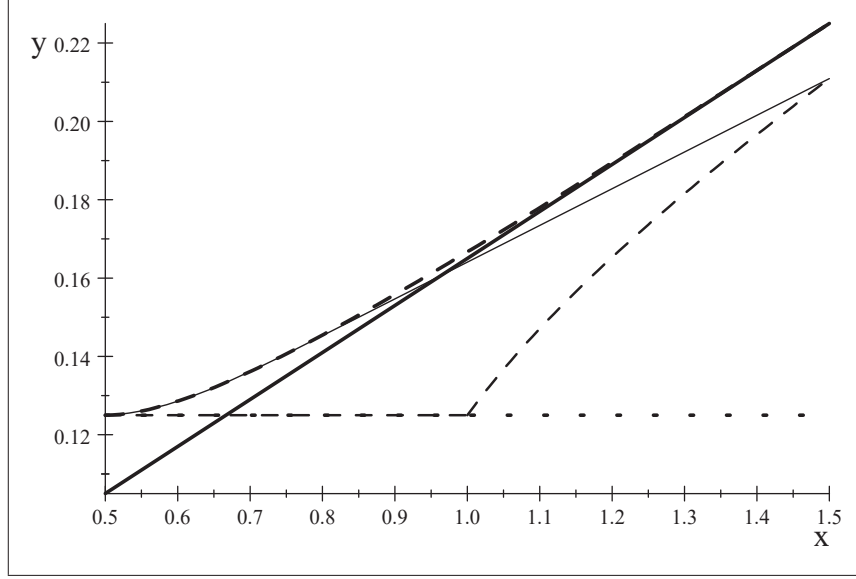
So far we have assumed that the Territoriality Principle gives CA exclusive jurisdiction over both SEPs. If NT were instead imposed in a situation where no jurisdictional principles are employed, it would constrain CA in the same fashion that we have just seen. It would also constrain CB, since CB prefers a positive fee for its domestically-owned SEP, and a zero fee for the foreign-owned SEP. CB would prefer $r_1 = r_2 = \frac{1}{4}$. But this cannot be implemented, so the imposition of NT would induce CB to abstain from regulating (or equivalently set $m = \frac{1}{5}$). Consequently, imposing NT in a situation where no jurisdictional rules are applied, would take the outcome from $\mathbf{r} = (0, 0)$ to $\mathbf{r} = (r^{NT}, r^{NT})$.

A.4 Comparing joint welfare

We plot joint welfare as a function of α for the various cases as follows:

- $W^0 = W^{Nat}$ thick solid;
- W^J thick dash;

- W^{TP} thin solid;
- W^{ED} thick dots; and
- W^{NT} medium dash.



Hence:

- The best regime from a joint welfare perspective is the Territoriality Principle for $\frac{1}{2} < \alpha < \frac{27}{28}$, and the unregulated market (or the Nationality Principle, since it implements the same outcome) for $\frac{27}{28} < \alpha < \frac{3}{2}$.
- The National Treatment provision reduces joint welfare relative to the Territoriality Principle, and to the extent it affects the outcome, improves joint welfare relative to situation where both countries regulate both SEPs.

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Author contacts:

Henrik Horn

Professor of International Economics

Research Institute of Industrial Economics (IFN)

Stockholm

SWEDEN

Email: henrik.horn@econ-law.se